TRANSACTIONS

OF THE

GRAPHIC SOCIETY

OF

PENNSYLVANIA.

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TRANSACTIONS

OF THE

ODONTOGRAPHIC SOCIETY

OF

PENNSYLVANIA.

Odontographic Society

VOL. I.

PHILADELPHIA:
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TRANSACTIONS

OF THE

ODONTOGRAPHIC SOCIETY

OF

PENNSYLVANIA.

A MEETING of the members of the dental profession was held on Tuesday evening, May 19th, at Concord Hall, Philadelphia, for the purpose of organizing a dental society, whose object shall be to promote professional and social intercourse among dental practitioners, and to encourage a disposition for investigation, on their part, in every direction which relates to the principles and practice of the profession, and collateral science. The following gentlemen were present in person, Drs. Jacob Gilliams, C. A. Kingsbury, Thomas Wardle, J. F. Flagg, J. H. McQuillen, Wm. P. Henry, George W. Ellis, Ambler Tees, Wm. Gorgas, and by letter, Drs. J. L. Suesserot, of Chambersburg, John McCalla, of Lancaster, Chas. Woodnut, of Pottsville, C. S. Beck, of Wilkesbarre, and J. W. Moffatt, of Harrisburg.

On motion, the venerable Dr. Jacob Gilliams was appointed chairman, and Dr. Ambler Tees secretary.

A committee, consisting of Drs. McQuillen, Henry, and Flagg, was appointed to draft the constitution. On presenting their report, it was moved by Dr. Kingsbury that the plan of organization offered should be taken up section by section. This was done and adopted, as follows:—

CONSTITUTION.

Article I.—Name.

This organization shall be known as THE ODONTOGRAPHIC SOCIETY OF PENNSYLVANIA.

Article II.—Objects.

This Society shall be instituted with the view of promoting professional and social intercourse among dental practitioners, and to encourage a dis-

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position for investigation on their part in every direction which relates to the principles and practice of the profession or collateral sciences; with this object in view, essayists shall be regularly appointed to prepare dissertations embodying the results of actual experience, observation, research, and reflection on such subjects; the papers to be read at the monthly meetings, and to be subject-matter for discussion on the part of the members.

Article III.—Members.

This Society shall consist of Active, Corresponding, and Honorary members.

SEC. 1. The Active members shall consist of practitioners of dentistry residing in the State of Pennsylvania. They shall be 21 years of age, of good moral character, and possess a liberal education.

SEC. 2. The Corresponding members shall consist of practitioners of dentistry residing in other States of the Union, or in foreign countries, who manifest a disposition to advance the science and art of the profession by contributing to its literature.

SEC. 3. The Honorary members shall consist of practitioners of dentistry who have honorably retired from practice, or of medical practitioners or others who have made valuable contributions to the science or art of dentistry.

Article IV.—Officers.

The officers of this Society, to serve for a period of one year, shall be a President, two Vice-Presidents, a Corresponding Secretary, Recording Secretary, Treasurer, Librarian, an Executive Committee, (to consist of three members,) and such other officers as may be designated by the By-Laws.

Article V.—Powers.

This Society shall use one common seal, with such device and inscription as may be agreed upon, and grant to its members, in the manner and form prescribed by the By-Laws, such certificate as under its common seal may authenticate and perpetuate the memory of such membership.

Article VI.—Dissolution.

In case a dissolution of this Society shall at any time be proposed, a meeting shall be called specially for that purpose, and the consent of three-fourths of all the members shall be required to effect it. Should the Society be thus dissolved by its own act, the property belonging to it shall be sold by order of the President, or any three members, who shall first obtain authority from a majority of the surviving members. The proceeds of such sale shall be equally divided among said survivors.

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Article VII.—Amendments.

The Constitution and By-Laws may be altered and amended with the consent of three-fourths of the members present; the proposition, stating the amendment in writing, to be submitted by five members at the annual meeting, and lie over until the next annual meeting.

BY-LAWS.

Article I.—Members.

Sec. 1. Candidates for membership may be proposed at the stated monthly meetings. Recommendations for the same being made in writing, and signed by two of the members of the Association. The name of the candidate shall then be referred to the Executive Committee, and, if his qualifications be satisfactory to a majority of the committee, the Chairman shall, at the next monthly meeting, propose him as worthy of membership, whereupon he shall be balloted for, two-thirds of all the votes cast being necessary for an election.

Sec. 2. No person shall be entitled to the privileges of active membership until he shall have paid the initiation fee, and, if he omit the same for one year, his election shall be void.

Article II.—Dues.

The initiation fee for active membership shall be three dollars, payable at or before signing the Constitution. The annual contribution shall be two dollars, payable at the annual meeting. Any member who neglects to pay his annual contribution two successive years shall cease to be a member without action of the Society, provided the Treasurer has notified him of his indebtedness. Corresponding and Honorary members shall be exempt from the payment of all dues, and, as a mark of distinction for long-continued service in the profession, by special action of the Society the dues of an Active member may be remitted.

Article III.—Privileges of Members.

Active members shall be entitled to debate and vote on all questions discussed in the Society, and be eligible to any office in the gift of the organization. Corresponding and Honorary members shall be entitled to a seat in all meetings of the Society, and have the privilege of debating all questions not involving pecuniary expenditure.

Form of Certificate of Membership.

ODONTOGRAPHIC SOCIETY OF PENNSYLVANIA.

This is to certify that the members of the Odontographic Society of Pennsylvania, as an acknowledgment of their recognition of the ability and integrity of , have elected him a member of the Society.

In witness whereof, we have hereunto annexed the names of the proper officers, and the seal of the Association, this day of

President.

[SEAL.] *Corresponding Secretary.*

Recording Secretary.

Article IV.—Resignation or Expulsion of Members.

SEC. 1. Any member shall have leave to resign upon application made therefor in writing, provided all arrears due from him to the Society have been discharged.

SEC. 2. Any member may be impeached by three members for contravening the laws of this Society, for malpractice, or other gross misconduct. The member so impeached shall have transmitted to him a written copy of the impeachment, with the notice of the time of hearing before a committee of five members appointed for that purpose, which time shall not be less than one month after the member shall have received such notice; then, if the report of said committee sustain the impeachment, the Society, at a special meeting appointed for the purpose, may by ballot suspend or expel such member by a vote of three-fourths of all the votes cast.

DUTIES OF OFFICERS.

Article V.—The President.

The President shall occupy the chair at the meetings of the Society, preserve order, regulate the debates, and perform all the duties that custom or Congressional usage may require, and shall deliver an address at the close of the year on retiring from office.

Article VI.—The Vice-Presidents.

The Vice-Presidents, in the absence of the President, shall assume all the duties of that officer, and, in the absence of these officers, a chairman pro tem. shall be appointed *viva voce.*

Article VII.—The Recording Secretary.

The Recording Secretary is to take and preserve correct minutes of the proceedings of the Society, to notify members of the meetings, to keep a

correct list of the members of the Society, with the date of their election, resignation, or death, and to lay before the Society, at the annual meeting, a summary of its transactions for the preceding year.

Article VIII.—The Corresponding Secretary.

The Corresponding Secretary is to conduct the correspondence of the Society, and acknowledge all donations made to it. He is to notify members of their election, keep correct copies of all letters written on the business of the Society, have the care of the certificates of membership, have them filled up, signed, sealed, and forwarded to active, corresponding, and honorary members, except in cases where the active members fail to pay the initiation fee and annual due of the Society. He shall present such communications on the science and art of dentistry, or collateral sciences, as he may receive from members or others at the monthly meetings, and shall read a minute of his transactions for the year at the annual meeting.

Article IX.—Treasurer.

The Treasurer shall take charge of the funds of the Society, and attend to the collection and payment of moneys; but no moneys are to be paid by him without an order signed by the President, and countersigned by the Recording Secretary. He is to keep a clear and detailed statement of all receipts and expenditures, which is to be laid before the Society at the annual meeting, and shall deliver up to his successor, on retiring from office, all the books, papers, and funds in his hands belonging to the Society.

Article X.—Librarian.

The Librarian shall take charge of all the books and manuscripts belonging to the Society, keep a correct list of all donations or deposits of books, of those missing or lent, and to report on the state of the library at the annual meeting.

Article XI.—Executive Committee.

The Executive Committee, (three in number,) with the President and Secretaries as ex-officio members, shall have a general superintendence of the affairs of the Society, particularly the publication of its transactions. They shall ascertain the qualifications of candidates for membership, and report the same to the Society, and they shall select twelve or more members annually to prepare essays to be read at the monthly meetings.

Article XII.—Delegates.

In accordance with the Constitution of the American Dental Association, one representative for every five of the active members of this Society shall be annually elected as delegates to that body.

Article XIII.—Special Committees.

Special Committees shall be appointed in the manner sanctioned by ordinary usage. The reports of all committees are to be made in writing and entered at length on the minutes, unless otherwise ordered by the Society.

Article XIV.—Meetings.

SEC. 1. The stated meetings shall be held on the first Tuesday of each month of the year at eight o'clock P.M. All the meetings, with the exception of the annual meeting, shall be devoted to the reading of essays and the discussion of subjects connected with the principles and practice of dentistry and collateral sciences. The recommendation and election of members and donations to the library will be in order at these meetings, but no other business shall be brought forward.

SEC. 2. The annual meeting in May shall be appropriated to the election of officers, the financial concerns of the Society, receiving reports of committees, and, in general, to such business as does not appertain to the scientific transactions of the Society.

SEC. 3. Special meetings may be convened by the President, or at the request of five members.

SEC. 4. Five members shall constitute a quorum.

SEC. 5. Strangers may be introduced by a member at the meetings devoted to discussion.

SEC. 6. The order of business at discussional meetings shall be:—

1. Minutes of last discussional meeting.
2. Recommendation and election of members.
3. Donations to the library.
4. Written communications.
5. Verbal communications.
6. Adjournment.

SEC. 7. The order of business at the annual meeting shall be:—

1. Minutes of last annual meeting, along with a synopsis of the transactions for the preceding year.
2. Reports of officers.
3. Reports of committees.
4. Deferred business.
5. New business.
6. Elections.
7. Address from retiring President.
8. Adjournment.

SEC. 8. In all such points of order as are not noticed by these by-laws, the Society is to be governed by Congressional usage.

Article XV.—Donations to the Society.

Any person who shall present books, money, or other property to the Society shall be considered a benefactor thereof, and his name, with mention of the gift, shall be recorded in a book for that purpose, the yearly entries in which shall be read at the annual meeting.

Article XVI.—Transactions.

Sec. 1. The Transactions of the Society, under the designation of Transactions of the Odontographic Society of Pennsylvania, shall be printed at such times and in such manner as the Executive Committee shall direct.

Sec. 2. Newly-elected active members, who have paid their initiation fee and annual dues, shall be presented with the Transactions for the session in which they are elected, and shall be entitled to a copy each successive year on the payment of their annual dues; but no old member, whose dues are in arrears, or newly-elected member, whose initiation fee and annual dues have not been paid, shall be entitled to the Transactions.

Sec. 3. The Transactions shall be purchasable by all members of the Society, and others, at their prime cost, and be exchanged for the Transactions of other Societies.

J. H. McQuillen,
Wm. P. Henry,
J. Foster Flagg,
} *Committee.*

On motion, the meeting resolved itself into an association, with the understanding that all who co-operate in person, or by letter, should be regarded as active members, and accepting the above as the Constitution and By-Laws of the Society. On account of the late hour, the meeting adjourned until Thursday evening at eight o'clock.

An adjourned meeting of the Odontographic Society was held on Thursday evening, May 21st, 1863, at Concord Hall, for the purpose of electing officers for the ensuing year.

On motion, Dr. Wardle was appointed chairman, and Dr. Louis M. Lusson secretary.

The following gentlemen, who were prevented from attending the former meeting, were present on this occasion, in person: Drs. Louis M.

Lusson, S. R. Scrivens, L. D. Eveland, of Williamsport, and H. Libert, of Norristown.

On motion, the nomination and election of officers was declared in order, and on ballot resulted as follows:—

President.—Dr. Jacob Gilliams, of Philadelphia.

1*st Vice-President.*—Dr. John McCalla, of Lancaster.

2*d Vice-President.*—Dr. C. A. Kingsbury, of Philadelphia.

Corresponding Secretary.—Dr. J. H. McQuillen, of Philadelphia.

Recording Secretary.—Dr. L. M. Lusson, of Philadelphia.

Treasurer.—Dr. T. Wardle, of Philadelphia.

Librarian.—Dr. Wm. P. Henry, of Philadelphia.

Executive Committee.—Drs. J. F. Flagg, Gorgas, and Wm. S. S. Scrivens.

A number of gentlemen were nominated as corresponding members of the Association, and referred to the Executive Committee.

The Executive Committee presented the names of the following gentlemen as essayists for the ensuing year: *June*, 1863.—Dr. C. F. Fitch, of New York. *July.*—Dr. J. F. Flagg, of Philadelphia. *August.*—Dr. S. R. Scrivens, of Philadelphia. *September.*—Dr. Wm. Gorgas, of Philadelphia. *October.*—Dr. Ambler Tees, of Philadelphia. *November.*—Dr. John McCalla, of Lancaster. *December.*—Dr. Louis M. Lusson, of Philadelphia. *January*, 1864.—Dr. Chas. Woodnut, of Pottsville. *February.*—Dr. G. W. Ellis, of Philadelphia. *March.*—Dr. J. H. McQuillen, of Philadelphia. *April.*—Dr. T. Wardle, of Philadelphia. *May.*—President, Dr. Jacob Gilliams, of Philadelphia.

A monthly meeting of the Odontographic Society was held on Tuesday evening, June 2, 1863, at eight o'clock.

President, Dr. Gilliams, in the Chair.

The minutes of the previous meeting were read and adopted.

Several gentlemen were proposed as candidates for membership.

Dr. C. P. Fitch, the essayist of the evening, residing in New York City, and finding it impossible to be present, offered his paper through one of the members, by whom it was read as follows:—

Mr. President and gentlemen of the Odontographic Society of Pennsylvania, while cheerfully responding to the appointment of the Chair in the preparation and reading of a paper for your consideration, and in view of the fact that it is made an introduction to the exercises of the evening, I feel impressed with the necessity of making my re-

marks partake of the nature of suggestion rather than to push any one line of thought to its ultimatum, or indulge in the prolixity and elaborateness of minute detail and logical deduction.

The subject which I present for your reflection is the "PATHOLOGY AND TREATMENT OF DENTAL CARIES." This is one of the most trite and familiar of the entire range of dental diseases, though common, yet a correct understanding of its true pathology is none the less important. It is one of all others which the dental practitioner has mostly to combat, and one, I fear, the true character of whose pathology is by some but very little or cursorily studied. The practice, recognized and adopted by the profession, at least in one of its departments of treatment, seems to be quite radical, and is based upon correct notions of its ætiology; yet are we not too apt to receive and adopt the conclusions and deductions of the sages, the patient, plodding investigators in our profession, (for there is no royal, privileged highway to the temple of truth,) rather than take the trouble ourselves to subject every healthy and diseased structure of the oral cavity, coming within the range of dental practice, to a close, rigid, personal analysis? Therefore, if I can do no more than provoke here this evening a healthy and general expression of correct sentiment upon this subject, and excite hereafter a patient, faithful exploration of this disease in its various phases, I shall be amply rewarded and gladdened by the result. In the outset, allow me to say a word or two in reference to the terms employed as the caption or subject of this paper, for in the discussion of any and every question there is a seeming fitness, if not a necessity, for a community of understanding in regard to those expressions setting forth the subject-matter under consideration.

The term pathology is derived from two Greek words, *pathos* and *logos*, literally signifying a discourse upon disease, and by conventional usage comes to mean that branch of medicine which explains the nature of disease, its causes and symptoms, or, according to Dunglison, "that branch of medicine whose object is the knowledge of disease." It has been defined by some as diseased physiology, and physiology of disease. I propose to employ it as having reference to the nature and causes of disease.

Caries is a Latin word, and literally means, according to Ainsworth, rottenness, or the effects of the worm in wood and other things, or the dregs or lees of wine. As applied to bone it represents the devitalized product of irritation, congestion, inflammation, and suppuration. As employed in reference to the teeth it can have no such signification, so far as the several pathological conditions are concerned in the elaboration of bone caries, or so far as there is any similarity in the products of bone and dental caries. It simply means a destruction or rottenness of dental tissue. I employ it therefore as having reference to the destruc-

tion of dental substance without in the least indicating the causes of tooth decay.

To be brief, and assuming the position that the elements composing tooth structure are well understood, the pathology of dental caries may be considered under two aspects: its nature and causes. The nature of this disease is found to consist in the removal of one or more of the elements entering into its structure; the entirety of whose elements, in definite, relative proportions, constitutes its normal, healthy constitution. Not that all dental tissue is originally composed of elements similar and definite in their proportions, for in this difference of combination, consists the durability or frailty of dental substance. But what I wish to say in this connection is this, there is a standard of normal tooth structure, and it consists of similar elements definitely combined, and whenever found to be originally deficient in any one of these essential structural entities will more readily yield to the destructive influences of agencies hereafter to be mentioned. The removal of any one of these constituents composing a tooth involves in every instance a chemical act, and the product of this chemical reaction, in its peculiar and characteristic qualities, not only determines the character of the agent implicated in this destructive process, but most emphatically points to the remedial agencies requisite to a radical cure. A tooth being composed of organic and inorganic elements, it would be a legitimate inference to conclude that the removal of any portion of its animal or mineral substance, nay, further, the extraction of any one of the elementary constituents composing these different substances, would give a very different product in the character of decay; and this is found to be actually the case. An experienced, scientific dentist should readily detect, from the character of the residual decomposition found in a tooth, if not the quality of the structure itself, certainly the agent or agents operative in its destruction, as well as to determine the treatment. This feature of the subject is one of great practical moment to the practitioner, and furnishes material sufficient in and of itself, for extended remark. I think educators in dentistry should pause and linger just here in their instructions until these points become as familiar as household words. Proper instruction given in this direction would be tapping the matter at the root; it would be traveling and exploring in the regions of basal, fundamental dental truth, and its practical results would produce, at least in one direction, a beautiful harmonious completeness in the characteristic qualifications of those going forth to practice our specialty.

The causes of this pathological condition may be considered under two heads: general and specific, or constitutional and local. The first causes of dental caries are operative during the formative period, determining

the character of tooth structure. The second causes are in force during the subsequent life of the being. The regulation and removal of the first require early attention, even during gestation. The second come more directly within the range of dental practice, and are eminently amenable to treatment. By this remark I do not wish you to infer that I consider the first, or constitutional causes of tooth pathology, beyond the reach of appropriate dental medication, for I most certainly believe that eventually dental practice will come in just here to the aid of suffering humanity, and contribute, by suggesting appropriate diet and medication, to the *formation* of healthy tooth structure; yet the second causes, under the present entertained public and professional notions and views respecting the province and achievements of dental science and practice, are brought more directly within the sphere and exercise of professional skill, and should elicit the most thoughtful and careful investigation touching the origin and removal of these causes. The first or constitutional causes are predisposing; the second or local are more directly operative. The first arise from defective nutrition; the second have their origin in vitiated oral fluids, whether arising from organic or functional derangements, or from the disintegration of foreign substances deposited in and about the teeth during the act of mastication. The first pervert the vital or modalic force, the normal action of which is absolutely essential for the elaboration of a high type or development of tooth structure, as well as interferes with the proper supply, in quality and quantity, of that pabulum equally requisite for the construction of a perfect tooth; the second are purely chemical in their action, and from this fact more direct and potent in their results upon the tooth.

The treatment of dental caries naturally divides itself into two general divisions: *prevention* and *arrestation*. The preventive measures embrace all those means and appliances which tend to the formation of healthy tooth structure, and the preservation of that structure intact. These means comprise food, exercise, pure air, proper clothing, cleanliness of teeth and person, and medication when necessary. Means of arrestation consist in counteracting and controlling all unhealthy conditions and forces operating locally in the destruction of these organs. To mention but a single abnormity: vitiated oral secretions, which may arise either from excessive glandular excitement, produced by local excitants, and increased, concentrated nerve action, and from follicular derangements of the mucous surface however caused, or from the presence of decomposing ingesta derived from foreign matters deposited and retained about the teeth, should receive prompt and efficient treatment. To meet such local indications our therapeia must of necessity be both general and local.

But the most potent and direct measure for the arrestation of dental

caries consists in the removal of not only all decay, but, if possible, of all tooth structure but partially involved in the process of decomposition, and then excluding all local destructive agencies from the cavity by calling into requisition the very efficient practice, when properly performed, of stopping these cavities of formation with *gold*. And it is just here that the manipulative skill of the dentist is taxed to the utmost. This is the legitimate field for the display of dental genius. The indications presented and results aimed at demand most imperiously the highest order of operative talent and surgical adroitness.

Having said thus much, gentlemen, I close these few general remarks by citing two cases, from the many which might be mentioned, illustrative of my subject. The one came under my notice in early practice; the other more recently.

Case 1.—Miss A., age seventeen; of nervo-bilious, sanguineous temperament; teeth of good size, but slightly deficient in animal constituents; patient from a healthy family; no noticeable vitiated cachexia or diathesis other than an irritable condition of system from a chlorotic tendency. The upper incisors slightly decayed approximately. These cavities were stopped and the patient dismissed, with instructions touching the great importance of thoroughly cleansing the teeth two or three times per diem, and an early subsequent visit requested. Two years subsequently had a second visit; found most of the cavities very much enlarged, and some of the stoppings entirely out. Took more than ordinary pains in stopping these teeth a second time, thinking that the failure might have arisen from defective operations. After appropriate local treatment, my patient was dismissed a second time, with instructions of cleanliness, and to keep particular watch of these teeth, and to return in four or five months for further examination. Had another call about eighteen months after. Found two of the teeth entirely gone, and the others in a state of rapid decomposition.

In retrospecting this case from the now advanced stand-point of dental hygiene and therapeutics, I am convinced had this patient been put upon constitutional remedies, the teeth might have been preserved many years. In this case, the stopping of the teeth was but a part of the treatment which the diseased indications clamorously called for.

Case 2.—Mrs. B., of strongly-marked nervo-bilious temperament; age twenty-eight or thirty; the mother of two children; teeth well developed and of good quality; had lost the upper bicuspids and left upper central incisor; found the other central incisor beyond the reach of dental skill; blood thin and scorbutic; gums spongy and hemorrhagic; oral secretions thick, acid, and ropy; powers of life much reduced; teeth rapidly decaying. Dismissed the patient after directing proper topical

treatment and enjoining the absolute necessity of thorough constitutional medication at the hand of her physician, at the same time suggesting the syrup of phosphates, iron, citric acid in the form of lemonade, highly nutritious diet, beef to constitute, principally, the animal portion of it, with those vegetables rich in the mineral salts, and albumen.

The teeth were not stopped at this sitting. About two months subsequently received a second visit, with greatly improved general health; all the functions of the organism were restored to normal harmonious action; gums firm and healthy; oral secretions natural in their chemical reaction, thin and sparkling in consistency. The teeth were then thoroughly stopped, *secundum artem.* Since that period, which is going on now two years, the teeth and contiguous structures have remained healthy, and the results of this treatment have given much satisfaction to patient and friends. I feel fully convinced that had the teeth in this case been thoroughly stopped and the medication omitted, the salvation of these organs would have been impossible, and the operations upon them would have proved an entire failure. I hope these broad basal principles which underlie all true dental therapeutics, as recognized by some operators, will be speedily received and acted upon by our entire profession.

Dr. Kingsbury stated that he had been deeply interested in the reading of the paper presented to the Society this evening. In the "*Pathology of Dental Caries*" we had a subject of pre-eminent importance, and he regarded it as exceedingly appropriate and fitting that it should receive the first consideration in the discussions of this new organization, which has for its leading object the thorough investigation of subjects pertaining to dental science, and the diffusion of well-attested facts and correct principles among the members of our profession.

By the term "*caries,*" as applied to the teeth, we were to understand that process of decomposition or decay so universal in its extent, and so destructive and fatal in its consequences. Of all the diseases to which the human teeth are liable, this is by far the most serious. Although it has received the attention of pathologists for ages past, there is much in relation to it that is still involved in obscurity. Since the time of Hunter, however, considerable progress has been made. It may safely be said that we are greatly in advance of Fox and Bell. But there yet remains much light to be thrown upon this subject. Dental caries, instead of being the result of inflammation of the dentine, as was formerly supposed, is a chemico-vital process, or a chemical process attended with vital phenomena; a decomposition consequent upon a lack of vital power to preserve the organic structure in its normal condition, or the action of

some chemical agent having an affinity for some essential constituent of the dentine greater than its vital power of resistance.

The causes are both predisposing and exciting. Among the first might be mentioned constitutional characteristics, hereditary taint, a low degree of vitality, a febrile condition of the system, various forms of disease, numerous medicinal agents, and badly performed dental operations.

Another predisposing cause, not to be overlooked in this category, is the deficiency of calcareous material which exists in certain conditions of the system. Have you not observed that during the period of gestation there appears to be a decided abnormal tendency to decomposition of the solid tissues manifested in the rapid development and fearful ravages of dental caries? At such times there is more than the ordinary demand for the important constituents of the osseous structure—phosphate and carbonate of lime. The same deficiency is often met with in children.

He believed that sufficient attention had not been given by our profession to the necessity of regulating the diet of the patient in such cases, so as to supply ample material for the osseous structure to preserve its integrity under these peculiar conditions. He would suggest, whether we did not make a great physiological mistake in our general use of fine bolted flour, rejecting as we do the bran, which contains a large percentage of the phosphate of lime? In many cases the indications are that there is a lack of this element, and he believed that the proper exhibition of pure phosphate of lime would be followed by the most happy results.

Among the exciting causes, perhaps the first in point of importance is the vitiated secretions of the mouth. It is a well-established fact in physiology that while the mucous secretions of the mouth are acid in their character, the salivary secretions are alkaline. In their normal condition they doubtless bear such a relation to each other as to combine and form a neutral fluid that would exert no injurious chemical action upon the teeth. But any functional derangement of the system, inducing an abnormal condition of the salivary or mucous secretion, keeps up a constant supply of chemical agents, which prove so destructive to the dental organs. The retention of food between the teeth, until acetous fermentation takes place, is a prolific source of dental caries. Acetic, citric, and other acids, so profusely used in our daily diet, act in a most decidedly deleterious manner upon the teeth. When we take into account the causes already named with others not mentioned, together with the general neglect and abuse of the valuable organs with which we have to do, the wonder is not so much that they are so generally subject to caries, but rather that they are not totally destroyed.

Dr. Flagg said that, in speaking to the very able and interesting paper which had been presented for consideration, he felt the subject to be the

one probably least understood by dental practitioners. The treatment of caries, as it was usually presented to the practitioner, so far as it remained within manipulative confines, was pretty well understood, and, by a fair share of operators, creditably accomplished; but an understanding of its etiology and pathology general was only to be arrived at by careful and long-continued scrutiny. He referred to the fact that a gold medal had been offered by the Odontological Society of England for prize essays upon this very subject; thought that the suggestion was worthy of imitation, in that it was a candid acknowledgment of the limited information possessed in this direction, and the indication of a proper desire that work should be done toward eliminating something that might be serviceable to humanity and creditable to dentistry.

He thought that while much action might be taken upon the suggestions offered by Dr. Fitch, it nevertheless was exceedingly difficult for the dental practitioner to obtain even the results that he absolutely ought to from the employment of remedies, from the fact that it was almost impossible to induce patients even to pay the requisite number of visits for proper and frequent examination, to say nothing of constant and long-continued medication or attention to diet. The very instances related in the paper would prove the truth of this position. He however advocated strongly the urgent representation of the advantage of proper dietetic regulations, and, when called for, such medication as experience had proven, or investigation should indicate, beneficial. Thought he had seen much more marked advantage arising from topical applications than from constitutional treatment; but was disposed to regard this as due to the fact that proper dentifrices and mouth-washes would be persevered in by patients much more persistently than medication in other forms, for, if antacid, astringent, stimulant, or antiseptic preparations were ordered in this guise, and insisted upon at every visit, their employment soon became a habit. Could recall case after case, in which the constant use of simple precipitated chalk had been provocative of wonderfully satisfactory results.

Thought that it could not be disputed that those who chewed tobacco had unusual exemption from the ravages of dental caries, but was entirely indisposed to attribute this to any other property of the tobacco than to its efficacy as a sialagogue. Would call to mind the acidity of the mucous secretions and the alkalinity of the true salivary secretions, and would ask if it was not natural that the increased flow of saliva, incident upon the use of tobacco, should tend to preserve the alkaline character of the oral fluids, and thereby afford a barrier to the presence of such fluid as we know to be solvent of tooth substance? Acting upon this reasoning, he had prescribed and obtained good results from the use of such siala-

gogues as calamus, Canada snake-root, ginger, etc. Was constantly recommending, where indicated, the use of the marbled Castile soap, which, from its excess of alkali, was calculated to neutralize injurious influences about the teeth.

Would wish to be distinctly understood as taking this *practical* view of the method of considering and combating caries, very much more from its feasibility than from any belief in its superiority over the employment of agencies favoring the formation and nutrition of osseous structures, whether dietetic or therapeutic; and desired to avow his faith in the utility of constitutional treatment, having seen frequent instances of advantage apparently accruing from practice based upon the little light we have in this field.

Dr. McQuillen remarked that the majority of writers, in their efforts to account for dental caries, and disease in general, appeared to overlook or ignore the great law of *mutation* or *change* which pervades and controls everything in nature, animate and inanimate. Viewed in their broadest relations it would be found that the hardest mineral substance was no more exempt from the operations of this law, when certain influences were brought to bear upon it, than the softest organic structure in existence. It might be more *apparent* in the latter, but it was none the less *constant* in the former. It has been wisely arranged in the economy of nature, that this change should be constantly going on, so that there may be *reproduction* and *life.* With this end in view, a definite period of existence was assigned to all organized bodies, and when that period has been reached, the elements of which they were composed form new combinations. Even during the existence of such organisms, an incessant change takes place; for each component part, while it contributes to the life of the entire being, possesses an individual life of its own; this last being dependent upon the due performance of its vital actions. Thus each *molecule* of organic matter has its definite period of existence, during which it performs its legitimate duties and then dies. This has been properly named *molecular death,* in contradistinction to *somatic death,* or death of the entire body. It was this molecular disintegration in organic bodies which calls for the function of nutrition, to supply the waste of tissue thus induced. As long as the supply was equal to the demand, and duly appropriated, the health of a part would be maintained; but a divergence in either direction would induce an abnormal or diseased condition. This was true of every tissue in the body, modified, of course, by the position which the various tissues occupy in the scale of vitality. Thus the dental tissues, although placed in the lowest scale, come within the boundaries of this law. It was the recognition of the foregoing, which prevented him from adopting the purely

chemical theory as the proper explanation of dental caries, and in place thereof to regard the chemico-vital as the more satisfactory; for he had reason to believe that perverted nutrition would facilitate the action of chemical agents upon dental tissues; and, on the other hand, that a perfectly sound tooth, whose nutrition was unimpaired, would be able, from its inherent vitality, to resist or counteract to a great extent such influences. In illustration of this, reference was made to the destructive action of *gastric* juice upon the coats of the stomach after the death of an animal, which during its life produce no such results.

With regard to the best means of securing perfect dentures, there could be no doubt that a proper attention to the diet in infancy, childhood, and the adult period would go far toward securing such a desirable result. To this end the habitual use of food rich in the phosphates and carbonates of lime could not be too strongly insisted upon.

Dr. Gilliams remarked that the chemical theory of decay was that generally entertained at the commencement of his career as a practitioner of dentistry, sixty years ago, and the progress of caries was then ascribed to the influence of an agent which was termed septic acid. He related a very interesting case in which decay, owing to the abnormal position of the tooth, had commenced at the apex of the root. This was the only case of the kind that had ever fallen under his notice: from this peculiar characteristic he had shown it to the late Dr. Koecker, and it was deposited in the collection of the Academy of Natural Sciences.

Dr. Gorges said that he regarded the chemical theory of caries as correct. His observations had convinced him that the use of tobacco has a preservative tendency; he had frequently noticed, in the mouths of those addicted to its use, evidences of very *slow* decay, and, in many cases, its entire arrestation with an apparent increase of density in the tooth structure; he thought its preservative influence might be due, as remarked by Dr. Flagg, to the increased flow of saliva which it induces, thereby diluting or removing all acid secretions. Although sugar occasions pain by contact with an exposed nerve or the sub-enamel membrane, he did not think it acted chemically in the destruction of tooth substance. He thought that the tartaric acid used for acidulating fruit-drops and other kinds of confectionery acted powerfully upon the earthy constituents of the teeth.

Dr. Kingsbury remarked, in regard to the effect of tobacco, that after close observation for more than twenty years' practice he had good reason to believe that its moderate use, either in smoking or chewing, acted as a preventive of dental caries. He did not incline to this opinion in order to excuse or palliate a bad habit in any one, neither was it from any personal bias, as he could state that he did not use the "noxious weed" in

any form. He had almost uniformly observed that the teeth of his patients who used tobacco were better than those who did not use it. He would except, however, that class of persons who use it in the form of snuff. He never met with a snuff-rubber whose teeth were not in a most horrible condition—not that they were so badly decayed, but the gums were always in a diseased condition, and the entire oral cavity in an indescribably filthy state. He was glad, for the sake of the profession, that persons using it in this form were seldom met with in this section of the country. Strong reasons occurred to his mind why the moderate use of tobacco, smoked or chewed, should tend to retard the progress of dental caries. When chewed or smoked, it generally stimulated the salivary glands, and as a consequence the fluid in which the teeth are constantly bathed was of a strongly alkaline character. Tobacco possesses an antiseptic property. According to good authority, tobacco smoke contains, with other constituents, carbonate of ammonia, resin, carbonaceous matter, and nicotina—the chemical properties of all of which would be favorable for counteracting the decomposition of the teeth. He gave expression to these views as the result of long and careful observation. He felt it his duty to honestly state the facts, and his conviction. He did not wish to be understood as indorsing a bad practice, or in any way advocating the use of the weed, even in view of the facts stated; for he fully believed other prophylactics, less offensive and much more efficient, were within the reach of every one.

Dr. Wardle said he could very freely admit the possibility of the production of a better order of teeth; but, while admitting the possibility, doubted the probability, because of the artificial manner in which we live. The young of this age and climate are brought up on candies, sweetmeats, and confections, with pastry made from flour passed through a thirty-nine bolting-cloth, and the miller complained of because he does not produce it still finer. From these and other causes are the inhabitants of this region cursed with bad teeth. Did not wish to be understood as saying that these are the only causes which are active in the production of caries of the teeth. That is by no means the case, for their name is legion, and their origin the fall.

For the results of different modes of living, we need but look at the teeth in the mouths of Europeans. The children are not found with such decomposed deciduous, nor the adults with such fragile teeth as we find on this continent, particularly in our large cities. We ask ourselves the reason, and our examinations answer, they live better, that is, nearer to nature, circumstances in most cases compelling them so to do; and those who have the means to live in luxury, live solid, but not pampering; hence, in both classes, they have such strong, well-developed organs of

mastication, which rarely decay, (it being the exception,) but frequently drop out of the mouth, in old age, as it is said, perfectly sound.

Let us turn our attention to the teeth of children and adults of our cities, where we lay claim to a high state of culture, which means with many indulgence.

He practiced very many years before he could believe in the theory that saccharine matter was injurious to the teeth. All the experiments which had at that time been tried and reported, had failed, he considered, to establish the fact. He needed the evidence.

On one occasion a small boy came into the office; he was not over fourteen years old, very small for his age. He said: "Sir, I want you to put me in some teeth." He looked into his mouth, and was astonished, exclaiming, What have you been doing with your teeth, my boy? "O, sir, I am a candy-maker, and all candy-makers have bad teeth." All the teeth in his mouth were reduced down even with the gums, save the four canine teeth, which could not, in the nature of things, have been developed much over two years. This was the first *stumper* of an argument he had received on saccharine matter exerting a powerful effect on the teeth of the young.

On another occasion, a girl of about thirteen presented herself for the extraction of a tooth. On looking into her mouth, his attention was fixed on a peculiar round cavity in the centre of the face of the central incisor, about three-sixteenths of an inch in diameter. Being accompanied by her sister, he was prompted to look at her teeth, when, to his surprise, he found a like condition existing, which induced him to make some inquiries. He was informed that their mother had upper teeth inserted; father's teeth were good; had one older sister, she had good teeth. The next point he wished to arrive at was this, viz., Does your mother keep shop? Answer. Yes. Has she kept it a long time? No. Thus he arrived at what had been suspected, *i.e.* that these children indulged in the use of candy while their teeth lacked density, and consequently power, to resist decomposition, which in after years is acquired by the increased hardness of the adult teeth.

He has been able to detect in the mouths of the young when much candy has been used, and makes it a point to advise them against it.

As to the preservative influence of tobacco on the teeth, he thought it obtains much credit for so doing, because of its narcotizing effect upon an exposed nerve or tender dentine. He was more inclined to believe that if tobacco is at all beneficial to the teeth, it is by the constant grinding which is maintained. But this is a poor compensation for the presence of the nasty weed in the mouth of any individual.

The faithful use of the teeth on properly prepared food, which requires

masticating before it is taken into the stomach, has much to do with the preservation of the teeth. Good plain living, ample use of unbolted flour bread, an article which he has used more or less for years, and, finding it good for both body and soul, he recommends it either to relieve or prevent dyspepsia.

Living on food so dainty and refined that needs only to be rolled over in the mouth once or twice to enjoy the sweet morsel, and then swallowed, is anything but good for the patient, although it may help the dentist to *live*.

Dr. Gilliams said that he did not regard the action of sugar as injurious to the teeth; on the contrary, had been struck, when traveling through the South, with the fact that negroes employed upon sugar plantations were remarkable for the perfection of their teeth as well as their strong and healthy constitutions.

Dr. Lusson said that the French and Spanish were comparatively exempt from the ravages of caries; this fact he was disposed to attribute to the perfection of their culinary departments, the thorough preparation of the food facilitating its absorption and assimilation. He did not regard sugar as injurious to teeth; on the contrary, among the people before referred to, had observed that it was consumed in enormous amounts without any perceptible influence upon those organs. He thought the use of tobacco contributed to the preservation of the teeth, and, probably, most effectually when consumed by smoking.

Dr. Flagg was not disposed to regard the direct action of sugar upon tooth substance as injurious; had placed a tooth in syrup of sugar, and, after some years, it still presented an unchanged surface. Thought that the habitually excessive use of sweets was eminently injurious, both to general health and teeth; but regarded the effect upon the teeth as secondary, and only pronounced as the result of perverted nutrition, acid eructations, and general functional derangement. Had oftentimes noticed very defective teeth as concomitant with avocations conducive to undue consumption of saccharine substances.

Dr. McQuillen stated that the testimony of writers generally was in confirmation of the observations just made by Dr. Gilliams, that the negro slaves upon sugar plantations are remarkably exempt from dental caries, notwithstanding the fact that during the cane season they consume large quantities of saccharineous matter. With regard to the action of tobacco upon the teeth, although not favorable to its use, he did not think it exercised a directly deleterious influence upon the teeth. The constant chewing attendant upon its employment was calculated, however, by the mere act of attrition, to wear away the teeth in the most rapid and destructive manner; every one present no doubt had

frequently observed the teeth of inveterate chewers worn even with the gum.

Dr. Ellis said that the subject of the paper was one possessing much interest, and deserving of all the importance with which it had been credited. Although much of the mystery in which the origin of dental caries was formerly involved has been dispelled by the accurate researches of zealous investigators, as has been remarked, there still remains a fruitful and unexplored field, whose cultivation it is earnestly hoped will produce something capable of purifying the very fountain from whence arise all the influences deleteriously affecting the dental structures. The old and strictly chemical theory of caries has been generally abandoned for the acceptation of the chemico-vital theory; and he called to mind a very strong argument in its favor, given by Mr. Tomes in his valuable work on Dental Physiology and Surgery, where he states that when the crown of a tooth is totally destroyed by caries, the disease on reaching the fang is either partially or entirely arrested, as from its clothing of highly organized cementum it possesses a greater degree of vitality, and is better able to resist decomposition. He thought that the polish acquired by friction or eburnation would materially retard the progress of caries, from the fact that the decomposing fluid was thereby excluded from the tubuli, and the surface exposed to its action greatly diminished. The attraction which is known to exist between liquids of different densities would, when the dentine is exposed, probably account for the loss of vitality in that substance which is supposed to exist in the tubuli, and upon which the surrounding intertubular tissue depends for its support; this being removed, the action of the vitiated oral fluids is unimpeded. Tobacco, he believed, contributed to the arrestation and prevention of caries in several ways, through its agency as an antiseptic, and by means of its cleansing properties, both directly by friction, and indirectly, as stated by Dr. Flagg, through its influence as a sialagogue. Sugar he had never regarded as injurious to the teeth, only so far as its injudicious use would, through derangement of the digestive functions, secondarily affect those organs. There is a common prevailing habit, which, from the statements of that reliable and accurate observer, Mr. Geo. Catlin, may be regarded as a prolific source of caries, viz., "breathing through the mouth;" his arguments are plausible, and the statistics given exhibit the frightful inroads made by this pernicious habit, not only upon the integrity of the teeth, but upon the health of the entire system; the subject has been agitated in one of the Western societies, and deserves close investigation, as offering another opportunity for combating caries—that fell destroyer of health, comfort, and beauty.

Dr. Gilliams said he had frequently noticed that the Irish, on com-

ing to this country with a fine set of teeth, would in a short time suffer pain and disfigurement from the rapid progress of caries; this he was disposed to attribute mainly to the injurious influences of the various dietetic luxuries which are so abundant here and so scarce in the old country. There might be additional influences at work, but this without question was the most prolific. The case of a young Irishman was mentioned who, when he first came to this country, had one of the finest sets of teeth which Dr. G. had ever seen; but in the course of two years caries made fearful havoc with them.

Dr. McQuillen thought that the retention of the fibres of meat between the approximal surfaces of the teeth was eminently calculated to induce decay, and when the teeth are close together it was exceedingly difficult to dislodge these fibres. By remaining for any length of time he had reason to believe that lactic acid would be liberated, and the well-known affinity of that acid for the phosphates and carbonates of lime, had only to be borne in remembrance to recognize fully the injurious results which must ensue. This view had a fair foundation, in the fact that Berzelius demonstrated the existence of free lactic acid in muscular fibre, over fifty years ago, and this has been confirmed by the observation of Liebig and others. The best way to remove such accumulation was through the liberal use of the tooth-pick.

Dr. Flagg regarded the chemico-vital theory of dental caries as that which offered the most perfect solution to the various phases met with in practice; but viewed the term "vital" as more indicative of the characteristics of decay, and the term "chemico" as more intimately relating to the immediate or exciting cause of this affection. Was disposed, from the experiments of Dr. Westcott, to regard the putrescence of meats between teeth as a doubtful cause of decay, but thought that anything between teeth, which was permitted to remain after having become saturated with vitiated, or, more strictly, *acidulated* secretions, would act as the vehicle, through the medium of which much injury might be done.

Dr. McQuillen did not consider that the *negative* testimony of Dr. Westcott's experiments should be taken as conclusive evidence against the view just advanced. The subject was worthy of investigation.

On motion, adjourned.

A MONTHLY meeting of the Society was held on Tuesday evening, July 7, at eight o'clock.

Vice-President, Dr. Kingsbury, in the Chair.

The minutes of the previous meeting were read and approved.

The Executive Committee submitted the names of the following gentlemen as candidates for membership: Drs. W. W. Wilkinson, G. Macknet, and E. J. Neall, of Philadelphia, Robt. L. McClellan, of Cochransville, and W. K. Brenizer, of Reading, Pa., who, upon separate ballot, were unanimously elected.

The following paper was then read on

"ORTHODONTIA,"

BY J. FOSTER FLAGG, D.D.S., PROFESSOR OF INSTITUTES OF DENTISTRY IN THE PHILADELPHIA DENTAL COLLEGE.

To the Members of the Odontographic Society of Pennsylvania.

GENTLEMEN:—In response to your appointment of myself as essayist of this evening, permit me to offer a short paper upon that division of dental practice which is denominated Orthodontia; and I beg your indulgence if, while passing over in the cursory manner which your knowledge of the subject would demand, the ordinary causes of malposition of teeth, such as habits, hereditary transmission, etc. I dwell for a few moments upon that most fruitful source of trouble, the extraction of deciduous teeth, either for the purpose of "making room," as it is termed, or for the relief of children suffering from toothache.

I contend that there can be no practice more contrary to all sound doctrines, and more surely conducive to deplorable results, than this—no treatment which is more indicative of total ignorance, not only in the direction of anatomical mutation and physiological truths, but in the special department of dental therapeutics; for, who that has received proper instruction, has not means at his command by which he can allay the pain incident to ordinary pathological conditions within and about the deciduous teeth quite as promptly, and much more agreeably to the little patients, than by compelling them to submit to the operation of extraction?

There are, however, two conditions which, in my opinion, demand prompt removal of deciduous teeth, whether they are or are not decayed, and whether they be loose or firm; and these are, when the superior permanent centrals present posteriorly to the deciduous centrals, or when the inferior permanent centrals present anteriorly to their predecessors. Under these circumstances, the removal of the superior *centrals* in the first instance, and the inferior *centrals* in the latter instance, would be conducive to the insurance of a proper commencement for the placing of the anterior permanent teeth. After this I should advocate as a rule, universal as anything can be in this life of change and accident, that all the other deciduous teeth be retained (as they can be readily and comfortably) until they are either removed by the children themselves, or

could be by the fingers of the dentist. I would not be understood as of the opinion that deciduous teeth *should be* removed with the fingers—though I very frequently thus remove them—but, in very many instances, from position or shape of roots, (if any exist, or if they only remain,) the removal may be effected more surely and gently by small forceps than in any other manner. I would at this time counsel against removing children's teeth with "elevators," for the employment of these instruments precludes any other than direct force, while some *rapidity* of motion is also desirable, with the view of lessening suffering, and with children I regard this rapidity objectionable, from the fact that quickness or suddenness of movement is productive of apprehension on their part, which is oftentimes more disagreeable to them than the endurance of pain; therefore, in an operation which must necessarily be almost painless, it is well that they should be *slowly* and *surely* made aware that such is the case.

I have extended these remarks further, perhaps, than would be strictly legitimate in a paper upon the *correction* of irregularities, were it not that I propose calling the attention of members to the fact that not only may irregularities be almost universally prevented by a proper maintenance of the deciduous organs, in order that they shall perform the part allotted them by nature during the period embraced between the seventh and eleventh years of life, but that they may be made to subserve the important office of remedying that most unsightly deformity of the face, caused by the protrusion of the inferior maxilla and consequent malocclusion of the teeth. For the correction of this form of irregularity, the ordinary practice has long been the adaptation of a plate over the teeth of the lower jaw, upon which inclined planes were so arranged as, by occlusion with the upper teeth, these should be forced outwardly, and, at the same time, some backward movement of the lower teeth be effected by producing a certain amount of change in the angle of the inferior maxilla. The application of this force is dependent upon one of two causes, viz., the persistent efforts of the patients themselves in closing the teeth upon the planes, or by means of pressure with elastic bands arranged over the head and under the chin, after the manner of the Fox bandage, for preventing luxation during extraction. By means of these appliances, the corrections of very bad cases of this irregularity are sometimes effected in astonishingly short periods of time; but, on the contrary, it is not unfrequently the case that month after month passes by without any manifestation of progress, and I have operated for many patients who, after a due trial, (as they or their parents thought,) had abandoned the apparatus which, while so unsightly, so worrying, so productive of pain, and so unpleasant from accumulations of food, notwith-

standing daily visits to the dentist for its removal and cleansing, yet seemed to accomplish nothing which could be regarded as compensating for so much infliction.

These latter cases are never on account of the inefficacy of the apparatus, because of its efficacy there can be no doubt; but they are the result of a want of proper co-operation, or, in some instances, of intentional disobedience on the part of patients. Children will so protrude the lower jaw as to bite behind incredibly long planes, and, upon the least accession of tenderness, they will only eat such soft food as can be manipulated with the tongue, and never touch the planes at all. They will also complain of the hurting of the strap, and parents would rather discontinue its use than have their own or the children's rest disturbed, and thus the *dentist* accomplishes—*a failure!*

Now this conclusion may seem unjust, and yet there is much truth in it, for I think that in the correction of irregularities all apparatus should be *self-acting*—so constructed as to require no co-operation on the part of patients, and, moreover, so arranged as to prevent the possibility of their interference with its workings. In consequence of these views, I have, for several years, abandoned entirely the use of inclined planes, and have substituted for them, in correcting cases of the kind under consideration, a combination of wire, ligatures, and gutta-percha, which arrangement I can much more clearly elucidate by means of models than by description.

Fig. 1.

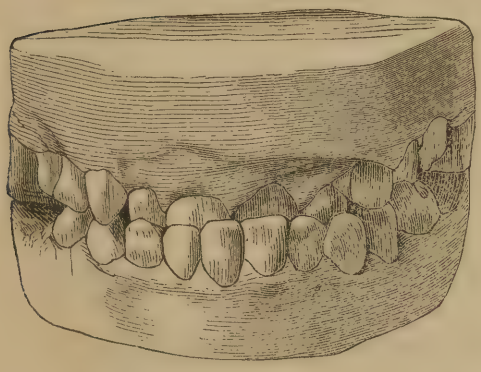


Fig. 2.

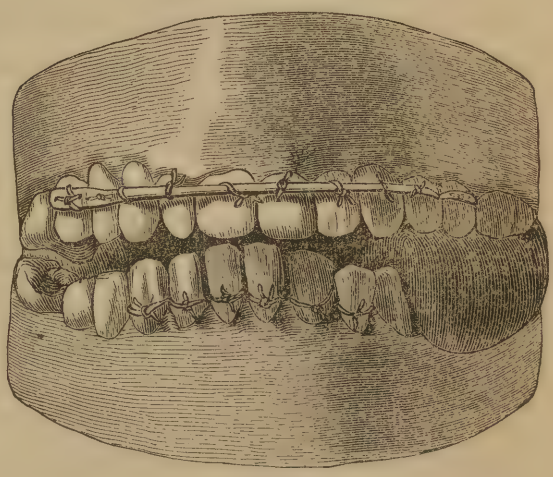


Fig. 1. Miss A., aged 14. Inclined planes had been adjusted upon the teeth of this patient, and worn for a period of one year. From want of co-operation upon the young lady's part, and from disinclination to bite upon tender teeth, no result was obtained.

Fig. 2. Front view, showing gold wire adjusted to upper teeth, silk ligatures thrown around lower teeth, and gutta-percha guard, to prevent occlusion, moulded upon left lower molars and bicuspid. The wire was secured by ligatures to the four superior bicuspids, and *one central* was gently brought forward by silk. After it touched the wire, it was firmly attached, and thus having gained strong points at either end and in the centre of the wire, the remaining teeth were brought into position with much ease and rapidity.

Fig. 3.

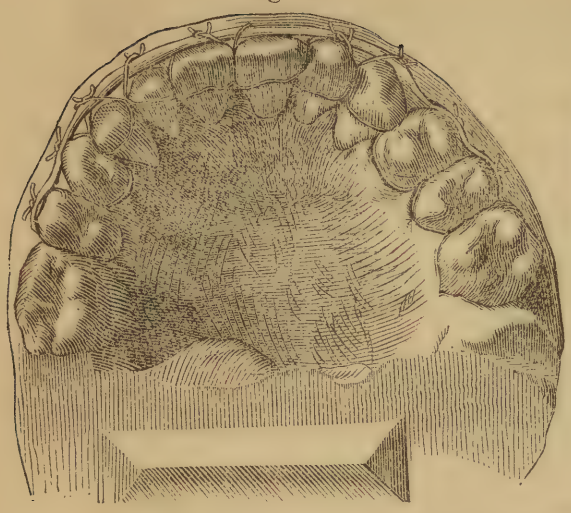


Fig. 4.

Figs. 3 and 4. Inside views of both jaws, showing attachments to wire upon upper teeth, and the apparatus which was used for *drawing the lower teeth in.* Silk ligatures were thrown around the twelfth year molars, (both sixth year lower teeth had been extracted by the gentleman who had employed the inclined planes with the view of insuring the correction.) India-rubber rings (from tubing) were secured to these teeth, and *attached together* by a short double *silk* ligature; silk was then passed around the lower front teeth, and the two rings stretched, as is very clearly demonstrated in Fig. 4.

It seems to me that every argument which could be adduced would favor the treatment which I here suggest, and that no arguments tending to oppose it can be presented which would have weight either with unbiased practitioners, or, what is of quite as much importance, the patients themselves. Parents and patients constantly, during the progress of "corrections," draw comparisons most unfavorable to the plate, plane, and strap method, either in the form of reminiscences in relation to their own sufferings, or congratulations in the comparative exemption from pain and annoyance which is enjoyed by their children. But time will not permit so lengthy a consideration of this part of the subject as might prove both interesting and instructive, and I therefore shall briefly consider (and illustrate by models) the possibility of great advance toward, and sometimes entire completion of, the correction of the irregularity under discussion, simply by due attention to the deciduous teeth and the application of an occasional ligature.

The fact of the more frequent presentation of the lower permanent teeth *posteriorly* to the deciduous is probably known to all of you, and it is my practice, both by teachings and ligatures, to prevent any attempts on the part of parents which shall result in removing or even loosening the deciduous teeth, so long as it is possible to retain them with any comfort to the patient. By this means the inward inclination given to the inferior permanent centrals is so great as to frequently insure their position under the superior centrals, and if it is indicated, by the presentation

of the superior centrals in the rear of the superior deciduous centrals, that this will not be accomplished, I at once remove the superior deciduous *centrals* and direct pressure to be made with the thumb on the palatine faces of the permanent centrals. The position assumed by the thumb is such as will at the same time naturally press upon the labial faces of the lower teeth, and thus a good result is almost always effected.

Fig. 5.

Fig. 5. Miss L., aged 7. All the *superior deciduous teeth* inside the inferior; marked protrusion of lower jaw; a family peculiarity.

Fig. 6.

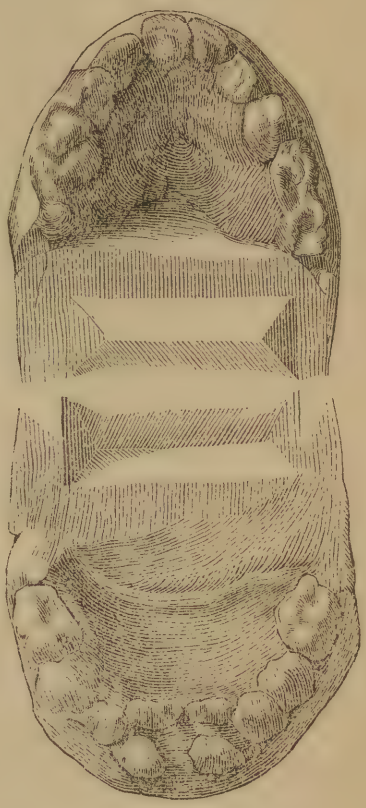


Fig. 6. The same, open; the deciduous inferior incisors were tied to the laterals to insure the presentation of the inferior permanent centrals *posterior* to the superior deciduous centrals.

I regard the accomplishment of a natural occlusion between the centrals as more than half the battle gained, for it will readily be seen, by examining the dental preparations of subjects under six years of age, that the position of the forming teeth is such as will indicate their being governed, to a very great extent, both as regards eruption and location, by the proper or improper placing of the anterior teeth, for the laterals are formed *posterior* to the centrals in the inferior jaw, and *anterior* to the centrals in the superior jaw. The models which I present for your inspection, and which it has of course taken two years to obtain, will demonstrate to you at once the feasibility and progress of such corrections as I have endeavored to describe.

It would be impossible, within the limits of a paper intended to inaugurate discussion, that any portion of the treatment of the various cases of

irregularity, which constantly present in ordinary practice, should be described. I wish it were otherwise; for too often do we read in our dental periodicals most elaborate descriptions of complicated adjustments of screws and tubes, plates and bars, springs, bands, and planes, in connection with diagrams of cases, which could be corrected more easily, more quickly, less painfully, and more satisfactorily, both to patient and operator, by the simple but efficacious adjustment of a few silken ligatures and a few rings of elastic tubing.

Fig. 7.

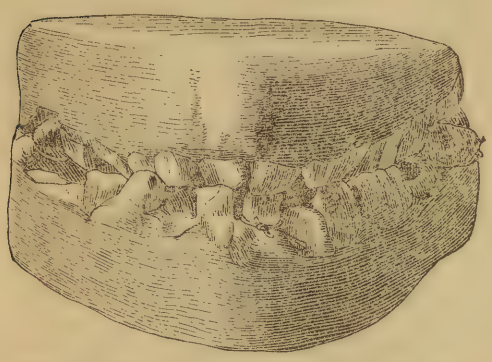


Fig. 7. The superior deciduous centrals were extracted upon the first indication of presentation from the superior permanents; the thumb used to make pressure to throw them forward; the inferior deciduous centrals have been lost naturally, and the occlusion is *almost* as would be desirable.

Fig. 8.

Fig. 8. The same, open; ligature securing slight rubber ring thrown around lower sixth year molar, and attached to left central, exercising *gentle* traction. Was tied on at 8 o'clock A.M., and at 1 o'clock P.M. was removed, and the tooth secured with silk, *completely under* its permanent antagonist; when the relative development of the other two teeth will *insure retention*, the same process will be repeated with them, probably in the course of two or three weeks from this writing. By this means a serious deformity will have been corrected without annoyance either to patient or practitioner; without trouble to the latter, and without pain or much expense to the former.

I would say, in conclusion, that one thing is indispensable for the accomplishment of good results by this method of treating irregularities, and that is, *a knowledge of knots*—for teeth are so shaped, so rounded, and so smooth that ordinary tying will not avail much. But there are knots which meet every emergency, from the "figure-of-8" for protruding incisors to the "secured loop" for turning the roundest tooth. These are only to be taught by demonstration, and acquired by repeated trial and some little experience.

Dr. Fitch said that he regarded the subject as one of great practical interest to the dentist, and thought that the paper just read had taken a practical and common-sense view of its various points. In the treatment of irregularities he had endeavored, as far as possible, to simplify the apparatus employed, thereby saving the time and trouble necessary for the construction of complicated machinery, avoiding the annoyance which such appliances occasion the patient, besides insuring a more rapid and certain result. In the use of the inclined planes he had seldom been successful, the failure resulting from want of co-operation on the part of patients, who will mostly devise every means to prevent occlusion of the tender teeth, thus defeating entirely the object desired. He had obtained the best results by the use of silk ligatures without waxing. He seldom employs rubber, on account of the *constant* traction maintained and the consequent soreness and liability to inflammation. This objection does not apply to the silk; and, while the rubber will soften in some mouths, allowing the teeth to recede into their former position, the silk will hold them firmly in place when moved.

He described a case in which he had expanded the arch and protruded the front teeth by means of bars and screws, an apparatus consuming considerable time in its construction, and believed that the same result might be obtained by means much less intricate and troublesome. He dwelt upon the importance of permanently ligating teeth after the correction of irregularities, sufficiently long to insure a deposition and organization of new tissue for their retention. He thought that many dentists did not recognize the direction in which the permanent teeth should present in relation to the temporary ones. This knowledge he regarded as indispensable to success in preventing and correcting dental deformities.

Dr. Wardle said he could appreciate the paper read by Dr. Flagg, and thought it of incalculable value. He had some experience in correcting irregular teeth, and thought if there was one part of our science more calculated than another to call forth the drudgery of thought, it is here, in the correcting of irregularities. There is great importance in knowing when to remove and when to leave deciduous teeth. He knew of a case in which all the deciduous teeth were removed before the seventh year. When consulted to do something for the child, as she could not masticate her food, having only the four centrals and the four molars, being somewhat amazed when asked what could be done, he replied, "There has been too much done already; the child must suffer until nature aids her." This treatment occurred in a high place, at least in a popular view.

He had treated some cases of extensive protrusion of the lower jaw, and has used Fox's bandage, which is recommended in his work, to prevent dislocation. He found it to perform well when properly applied.

He has now a case of the kind in hand—the young lady is eighteen years of age—which he undertook very reluctantly, on account of her age and the extent of the deformity, the inferior incisors projecting about three-eighths of an inch beyond the superior teeth. To the parents he admitted there was a bare possibility of improvement. They determined to have it tried. The case, in about six months from commencement, presented the incisor teeth even on their faces. He has yet to make some of the side teeth articulate. He had no doubt but that the cause of this deformity is owing to the want of tone in the muscles of the child during infancy. It is a well-known fact that the inferior maxilla of the infant is but slightly curved—it can scarcely be said to have any angle at the ramus of the jaw—hence, if there is a want of muscular power during early childhood, the maxilla will continue to elongate until the lower incisor teeth are beyond the superior incisors, producing the projecting chin and impaired enunciation.

Another case of irregularity had fallen under his care, viz., the projecting upper teeth, without any apparent cause, with wide spaces between each tooth, the front teeth presenting a fan-like appearance. The subject was a dental student, but is now an officer in the army. The case was commenced to rid the profession of what he would consider a lasting disgrace, should it continue in our ranks. To reduce these teeth to conformity, he made a plate to fit the palatine surface, which was retained by clasps to the side teeth; at the back part of this plate were two little eyes, about on a line with the lateral spaces; to these eyes were attached two small bits of rubber, and to the rubber four independent ligatures, having two strands each; each of these independent strands was fastened to a separate tooth, and occasionally changed until the four teeth were reduced to their proper place, and then retained by the usual means. The cause of this deformity was in consequence of sucking the thumb, a habit denied by the patient, but which the doctor detected him in during the progress of treatment.

Dr. Gorges said that Archimedes had been credited with saying, if he had a fulcrum to place his lever, he could move the world. The doctor, in his first attempts at the correction of irregularities, used almost exclusively metallic appliances as strong as could be swedged or fitted to the parts. He had met with much success in the use of inclined planes, especially in cases where the teeth were but partially developed. He has resorted to the use of rubber and thread ligatures; described a case, (the models of which were exhibited, representing the mouth before and after treatment,) in which, by ligatures, he produced what complicated apparatus failed to do. He uses thread, as the flax fibre possesses more contractile force than silk. He found, on suspending against a board, a

strand of thread and silk, each six inches in length, with flat weights attached, that, upon wetting them, the thread contracted a half inch, while the shortening of the silk was hardly perceptible.

Dr. McQuillen said that, as no remarks had been made with regard to the cause or causes of irregularities, he would take occasion to direct attention to four prominent causes. 1. Hereditary predisposition. 2. Bad habits. 3. Accidents. 4. Premature extraction.

1. Hereditary predisposition. The opportunities frequently afforded of observing the contracted jaws, or the disproportion between the superior and inferior maxilla running through families, passing from parents to children, were not only interesting as subjects of study, but also suggested that, where such predispositions were known to exist, the proper remedial treatment might be commenced at a sufficiently early period to obviate the difficulty; and it was possible that, by continuing this care, in the course of one or two generations the predisposition might be broken up. As an appropriate illustration of the hereditary tendency, he would direct attention to the plaster cast in his hand of the teeth of a little girl aged nine. It would be observed that the superior lateral incisors are very much behind the arch, and that they strike inside of the lower teeth. Exactly the condition of affairs exists in another cast, now offered, of the father's mouth. The grandmother of this family also had irregular teeth. The father applied to a dentist, when about eighteen years of age, to have the irregularity corrected, and, singular to say, was told that it could not be effected. The plan proposed for the little girl's case was to use an inclined plane of hard rubber, fitted to the lower teeth, and a silver bar, to be applied to the labial surface of the upper incisors, with gum-elastic rings passing back of the laterals. With regard to the inclined planes, he could not agree in tabooing them entirely. In some cases they had proved very useful in his hands. The hard rubber was preferable to metal, on account of the fact that the substance could be filed away so rapidly that but little time would be required in making any alteration demanded.

2. Bad habits. A common practice among infants after weaning, and frequently continued for years afterward, of sucking their thumbs, was a prolific cause of that form of irregularity in which the superior incisors bulge forward and rest upon the lower lip. The disposition on the part of parents to permit their children to indulge a preference for soft food, almost to the entire exclusion of everything that requires a decided effort in mastication, (as instanced in the rejection of crusts of bread, etc.) was also highly reprehensible. The force demanded and the shock attendant upon the mastication of hard food was of decided advantage in

enlarging and expanding the maxilla. The attention of parents should be directed to these facts.

3. Accidents. Under this head might be included the various casualties which children are liable to from falls, or being struck by balls, bats, etc., in which premature loss of the deciduous teeth is followed by a contracted arch. An interesting case of this kind had come under his care within the past month, in which the daughter of a neighbor, aged four, was struck in the mouth by a bat, in the hands of a boy. The right superior central incisor was knocked out of the mouth and the lateral loosened, so that the slightest touch severed the connection with the gum. Dr. McQ. saw the child one hour after the accident, and believing that an effort should be made to prevent the contraction of the arch, incident to the premature loss of the teeth, he replaced the incisor, after syringing the alveoli with tepid water; then closed the jaws of the patient tightly, and kept them so by Barton's bandage. In the course of the evening he mentioned the case and treatment to Dr. Garretson, who suggested the propriety of employing, in addition, gutta-percha as a splint, to keep the teeth in position. Accepting this as a valuable addition to what had been done, he called at the house of the patient, and after softening a piece of sheet gutta-percha in warm water, moulded it to the teeth and gums of the upper jaw, and then renewed the bandage, with instructions to the parents that it was not to be removed for two or three days, and that in the mean time the child was to be kept as quiet as possible, and to be fed on highly nutritious fluids, beef tea, chicken broth, etc. These instructions, however, were not carried out. By some means the bandage was loosened, so that the child could move the lower jaw, and she was allowed to eat as best she could, with the gutta-percha splint in her mouth, the ordinary articles of food. As a consequence of this, when the splint was removed at the end of three days, although the teeth were in their proper places, the central incisor was quite loose. In the course of that day the connection of the tooth was entirely severed, by the patient biting on a hard substance. No further effort was made to effect a reunion, and about a week after this the lateral was lost in the same manner. Although the treatment in this case was not successful in its results, it was instructive in its teachings. Had the patient been seen directly after the accident, or had the gutta-percha splint been kept in place, it was possible that reunion might have been effected. The plan adopted was worth trying again.

4. Premature *extraction*. Of this it was not necessary to say more than that the impropriety of such procedure is not only universally recognized by the profession, but the general intelligence of the people on this point is becoming more and more extended.

Dr. Kingsbury stated that the correction of irregularities of the teeth was a most perplexing branch of dental practice. In many cases it required great perseverance and patience on the part of both patient and operator. It is the least remunerative of any branch of his practice, yet it offered a field for the exercise of the highest order of inventive genius and skill.

He had almost abandoned the use of inclined planes, and had substituted gum-elastic rings and ligatures. Had treated recently a number of interesting cases, and had several in course of treatment at present; but the lateness of the hour would forbid his speaking of them in detail on this occasion.

Upon motion, the meeting adjourned to reassemble on Monday evening, July 13, for the election of delegates to the National Association, and the further discussion of the subject under consideration.

An adjourned meeting of the Society was held on Monday evening, July 13th.

Vice President, Dr. Kingsbury in the Chair.

The following names were presented by the Executive Committee, and, upon ballot, the gentlemen unanimously elected members of the Society: Drs. Geo. F. Platt, of Chambersburg, J. G. Garretson, J. Warner Knox, and Henry Ahl, of Philadelphia.

An election for the choice of delegates to represent the Society in the American Dental Association, to be held in Philadelphia on Tuesday, July 28th, was then entered into, resulting in the appointment of Drs. J. Gilliams, C. A. Kingsbury, Wm. Gorges, and Ambler Tees, of Philadelphia, W. K. Brenizer, of Reading, and John McCalla, of Lancaster.

The further consideration of "Orthodontia," the subject of the previous meeting, was then in order.

A member of the profession, who was present by invitation, exhibited the models, and gave an accurate description of a very interesting case, in which he had obtained the most perfect and gratifying result. The case was one of more than ordinary interest, and, judging from the description, presented unusual difficulties, not the least of which was the necessity of making the attachments of the apparatus to the very teeth which it was desirable to move. The various obstacles were met and overcome, and at the expiration of five months an irregular and disgusting set of teeth was transformed into an even and pleasing contour.

Dr. H. Townsend said that he had for the past three or four years employed inclined planes constructed of hard rubber; he regarded it as preferable to metal, being more readily adapted, easily bent to meet any

inclination, and feels clean and pleasant in the mouth. He sometimes rivets a piece of gold or platina to increase the thickness of the plane. He also employs rubber for upper regulating plates, and for the expansion of the arch finds it very efficacious. Rubber apparatus for the correction of irregularities would, he believed, eventually supersede the metals.

Dr. Wardle described a case in which he was engaged in moving the molars and bicuspids backward by means of wedges, in order to gain room for the reduction of an irregular cuspidatus. He wished to suggest an addition to the classification of causes of irregularity which had been offered, viz., that protrusion of the lower maxillary was sometimes produced by a laxity or want of tonicity in the masticatory muscles, allowing the jaw to drop, its own weight having a tendency to increase the angle and carry it both downward and forward; this idea he had never heard advanced, and it occurred to him as affording a satisfactory explanation of the cause of this condition.

Dr. Flagg thought that the removal of the permanent teeth might be classed as another cause of irregularity; those remaining so change their position as often to produce a very imperfect occlusion. He described and illustrated the various knots found useful in securing ligatures for the regulation of teeth.

Dr. McQuillen was pleased with the theory of Dr. Wardle, and believed, upon reflection, that certain cases which he had met with in practice were confirmatory of that view, the relaxation of the muscles having been quite marked. He called attention to the fact that Africans mostly have well-developed jaws, and teeth evenly implanted in the arch, cases of irregularity being exceedingly rare.

Dr. Townsend had noticed the fact relative to Africans mentioned by Dr. McQuillen, and had further observed the tendency to irregularity to increase in proportion to the admixture of white blood, the mulatto being much more subject to such deformities than the pure African.

Dr. Kingsbury dwelt upon the importance of the six year old teeth, and advocated the employment of every effort for their preservation, as contributing vastly to a proper position of the permanent set, and from their immediate value as masticatory organs; these facts he always endeavors to impress upon the minds of both parents and children.

Dr. Wardle said that as the association of ideas is always a great aid to the memory, he had adopted a very simple method of impressing upon the minds of parents the number of temporary teeth, in order that due attention might be given the six year old teeth upon their first appearance; his plan was to tell them that the number of temporary teeth is exactly the same as the number of fingers and toes, and he has had the

pleasure of obtaining from so trifling a suggestion most valuable and timely assistance from parents.

Dr. McQuillen moved that delegates be empowered to fill any vacancies that may occur in the number to which the Society is entitled, in order to insure a full representation—carried.

Adjourned.

THE regular monthly meeting of the Odontographic Society was held in the Philadelphia Dental College, Tenth Street, above Arch, on Tuesday evening, August 4th, at eight o'clock.

Vice-President, Dr. Kingsbury, in the Chair.

Minutes of the preceding meeting read and approved.

The Executive Committee reported the following gentlemen as candidates for membership, and on ballot they were duly elected:—

Active Member.—Henry Townsend, Philadelphia.

Corresponding Members.—Drs. C. P. Fitch, Wm. H. Atkinson, and Wm. H. Allen, New York; J. Taft, Cincinnati, Ohio; Abr. Robertson, Wheeling, Western Virginia; H. N. Wadsworth, Washington, District of Columbia; John Tomes, F.R.S., and Robert L. Hulme, M.R.C.S., London, England; P. Calais, Hamburg, Germany; Jos. F. Vegas, Bahia, Brazil; and Morize Heider, Vienna, Austria.

Several gentlemen were nominated for membership, and their names referred to the Executive Committee.

The following paper was then read:—

"DENTAL CARIES."

BY S. R. SCREVEN, D.D.S.

Mr. President and gentlemen of the ODONTOGRAPHIC SOCIETY OF PENNSYLVANIA: Having been appointed to read an essay on some subject appertaining to the theory or practice of dental surgery, I shall now endeavor to comply with the requirements of the society, by making some remarks on the disease known to us as *Caries*. Some gentleman at the first meeting of our society, very wisely remarked that this term (caries) was objectionable, as it did not properly convey a correct idea of the decomposition met with in the teeth; but as it is one that is generally adopted I deem it well to continue its use. It will doubtless be admitted by every practical dentist, that this disease is far the most destructive of any to which the organs of mastication are subject, and this fact is sufficient to show the very great necessity of a thorough understanding of its origin and progress.

I regret to say it has not been my privilege to witness or perform many

of the difficult, peculiar, and instructive operations, to arrest caries in its destructive nature, that most of the regular practitioners have had to encounter. Therefore the remarks I have to make at this meeting, so far as originality is concerned, are merely suggestive. Caries is a disorganization or decomposition of dental structure, originating in all cases from mechanical, chemical, or physiological causes; by a careful examination, the three causes conjointly may be observed as active agents in the destruction of carious teeth. We may have an imperfectly developed tooth, with the tubuli running into each other so as to form a very weak surface for mastication; consequently, it is liable to be mechanically injured without any undue force, and if so injured, chemical agents are always present and prompt to engage in the decomposition of all earthy constituents with which they come in contact. And to this imperfect development of the teeth may be attributed two-thirds of the demand for artificial dentures. If we regard man as he is, in his nature, perfection is nearly always deficient; and so we have a premature failure. If the teeth are taken into consideration we have a marked illustration of this; and so also do we meet with similar results in every part of the body.

Dr. Jenner's remarks on premature decay of the body are applicable here, as I believe many of the diseases spoken of by him are attributable to imperfect development. He says: "It is common for special parts to experience the decay proper to age; *not events*, but also long before other parts of the body decay. Thus one man is old as regards his scalp, his hair is gray or his hair-follicles have decayed and wasted, so as no longer to perform their function, and the man is bald; in another it is the alveoli which waste before their time; in a third, the heart and arteries; in a fourth, the nervous system. This tendency of particular parts to grow old before due time is sometimes hereditary. Early baldness, early falling out of the teeth, and an early aged look, we all know occur in many members of the same family at about the same period of life. So also we see member after member of the same family cut off about the same age by apoplexy, by heart disease, by asthmatic complaints as they are called. These diseases being the result, in fact, of degeneration occurring at or about the same period of life—the arteries, or the heart, or the lungs having been so constructed originally, as to begin to decay after so many years of ordinary wear; though care may retard, abuse hastens the decay, and so anticipate or delay the term natural to the individual. Men are old, then, physiologically considered, not when they have lived so many years, but when the structures essential to life have degenerated to a degree almost incompatible with the continuance of life."

Another point worthy to be borne in mind is the change in the osseous structure in advanced age; thus we find the bones of an old person more

liable to fracture than those of a younger one. This change is as observable in the dental structure as in any other class of bones in man. Those who have been fortunate enough to have arrived at the age of twenty-five or thirty years without ever being attacked with caries of the teeth, are apt to continue through the balance of life free from its disturbance. While on the other hand we notice a large majority in early life with almost every description of decayed teeth, alveolar abscess, exostosis, inflammation of the gums, and a diseased condition of all the organs in general, to continue through life unless the dentist or physician is sought to alleviate the suffering. Some writers maintain that caries is contagious. Dr. Koecker was of this opinion, and probably was led to this conclusion from the fact that decayed dentine will absorb and retain fluids that will act on the sound dentine, producing, as we sometimes notice, approximal cavities. Dr. J. Taft says in reference to Dr. K.'s views, that "the residue of decayed dentine is, in the soft decay, the animal elements, with a slight portion of earthy matter; and decay, in which the gelatinous portion is removed; the remainder is chalk-like, consisting mainly of phosphate of lime. In neither of these is there anything that can possibly operate on the healthy dentine." Some supposed its cause to be internal. Thomas Bell and many other distinguished authors were of this opinion. But the question, I believe, has been definitely settled that the exciting causes are external, and the predisposing cause internal or external. Predisposing causes are met with in all teeth; some are, however, more predisposed to caries than others—such, for instance, as those of a soft and delicate texture; while others presenting to the eye a yellowish appearance, very opaque and more dense in structure, are much less liable to it. Yet they are liable to a certain extent from their limy composition, which only requires the presence of an exciting cause, if sufficiently powerful, to develop the disease. The character of the disease in teeth of this description would, however, differ very much from those mentioned first. In the tooth of a transparent appearance, with a soft, delicate texture, we would find it bold and rapid in its course; while the tooth less predisposed to the disease could not be so readily affected. Exciting causes, as I have already mentioned, are met with externally chiefly in the form of acids; and these acids, penetrating the enamel, come in contact with the dentine, upon which its effects are soon manifested by a decomposition of this tissue in the direction of the tubuli, destroying layer after layer of bone, until the pulp cavity is reached. During this process the enamel may remain unbroken for a considerable length of time, and only indicating the disease by a dark-brownish spot.

This shell of bone may remain thus until some hard substance coming in contact with it crushes the walls, leaving, where a beautiful tooth once

stood, naught but an unsightly ruin for the study of the dentist who would elevate himself and his profession.

Dr. McQuillen, referring to the position assumed in the paper, that persons failing to live temperately and moderately, grow old prematurely, and that the structure and function of the various organs under such circumstances become impaired, remarked that this held with equal force in relation to the teeth; for the same violation of hygienic laws which proves destructive to the soft tissues of the body, exerts a deleterious influence upon the osseous and dental tissues.

Dr. Fitch, directing attention to the view enunciated by Dr. Atkinson before the American Dental Association, "that the expectoration of saliva was injurious to the teeth," said that while some persons might regard this as a visionary idea, he was disposed to give credence to it. When taking into consideration the fact that the saliva contains a large proportion of the phosphates and carbonates of lime, it will be readily conceded that in expectoration valuable constituents demanded by the nutritive functions are discharged from the mouth.

Dr. Flagg said that, although the subject had been very recently entertained for discussion, he was nevertheless pleased that it had again been agitated; the more so that it afforded him an opportunity to question as to whether, as dentists, we were not too much humiliating ourselves by the avowals of ignorance which all seemed willing to admit. He had quite recently stated it to be his conviction that this subject was the one probably least understood by the dental practitioner; but he wished to so far qualify this as to be distinctly appreciated. He regarded the specialty of dentistry as possibly entitled to rank as one of the best (if not the best) worked up of all the circumscribed emanations from the noble field of medical research, and could therefore regard with much favor the amount of knowledge possessed concerning even the "least understood" department. Thought that while the received etiology of dental caries would compare favorably with that of very many diseases which had for a far more extended period commanded the investigating talent of a much larger number of learned men, that it would also take decided precedence over the knowledge possessed in the direction of epidemic, endemic, and malarious affections; while the treatment, particularly the topical, would show results which contrasted favorably with that of almost any known form of disease. It was true that we were not unfrequently baffled while putting forth our best efforts, local and constitutional combined; but would ask in what direction was it not so? And would add, that when it was conceded that the education of the present day enabled us not only to recognize the same classifying peculiarities which obtained in other destroying action upon different tissues, gov-

erned, as they were, so markedly by what was termed "temperament," and which divided caries into the entire range from phlegmonous to erysipelatous, or, as it was termed, from rapid, soft, and light decay, to slow, hard, and dark decay, preparing us to diagnose quickly, prognose correctly, treat satisfactorily, and institute prophylactic measures which reasonably meet the indications, that it spoke well for dentistry and creditably for its practitioners. At the same time, he would by no means be understood as denying that there was an immensity yet to be demonstrated; he gladly hailed every accession of information, every suggestion of remedial application, and every report of obtained results. Would urge upon fellow-practitioners that they should embrace every favorable opportunity for the exhibition of such constitutional remedies as would probably or possibly induce such change as would tend to produce normal functional action where secretion was markedly vitiated, and to subserve the purposes of bone nutrition where it was evident such increase was required. Desired upon this occasion to add his confirmatory testimony to the statements of Mr. John Taylor, of the London Pathological Society, in relation to the action of the phosphates upon dentition; and would, as the result of his own experience, most heartily concur with him in recommending the employment of the hypophosphite of potash, with its appropriate nutrient, tonic, or stimulant adjuvants, in cases of infantile derangements consequent upon that effort of nature.

Dr. Tees remarked that defective organization was, without question, the most prolific cause of dental caries, and in many cases where this exists, the predisposition to decay was so great that all the efforts of patients and practitioners to arrest its progress appeared to be of no avail. The recognition of this fact, however, he thought should not prevent the dentist from putting forth every effort to remedy or retard the disease.

Dr. Wardle said he should go a step further on one point than the paper just read, "that man is nearly always imperfect." He believed man, as he is now constituted, *is* always imperfect. In regard to the decay of his teeth, he found, according to his observation, that there were two periods in the life of man during which the teeth were predisposed to decay. The first period was between twelve and eighteen years of age, then about the thirty-fifth or fortieth year for the commencement of the latter period of decay. He found this last development of decomposition far more difficult to arrest. He said he would much rather undertake to save the teeth of the young than of those whose teeth began to soften about the latter period.

Dr. Sill (of Pittsburg) recognized that excessive expectoration, from whatever cause it might arise, was eminently injurious to the human economy at large, on account of the debility resulting from the great

drain, and it was possible that the integrity of the teeth might be affected thereby; he was not prepared, however, to express an opinion on that point, as he preferred to give the subject more attention.

Dr. Fitch said that he heartily coincided with the views advanced relative to the general ignorance of the causes of disease, and thought that our knowledge of dental caries, its cause and treatment, was based upon a philosophical and sound basis. The results of local treatment on the part of the dentist left no room for doubt as to the propriety or impropriety of the course adopted; and while the same could not always be said of the general practice of medicine, it was the furthest from his intention to be understood as casting any disparaging reflections by such a remark. In the treatment of dental caries, the dentist should not depend exclusively upon local treatment, but be prepared to, and treat constitutionally when such a course was indicated.

Dr. McQuillen remarked that the *secretions* of the body are divided by physiologists into *recrementitial* and *excrementitial.* Thus the *urine* and *perspiration*, carrying as they do out of the economy materials which are not only not needed, (urea and the nitrogenous compounds generally,) but if retained would induce diseased action, are very properly denominated *excretions;* while the saliva, mucus, bile, and the fluid of the pancreas, on account of the peculiar and indispensable service which they render in connection with nutrition, are regarded as *recrementitial* in their character. Of this group, the saliva plays as important and as indispensable a part as the others. While he was not prepared to say what effect expectoration would have upon the teeth, he fully recognized that very large quantities of that valuable fluid (saliva) were unnecessarily wasted by the universal Yankee nation, much to the physical detriment of the inhabitants thereof. He believed that nature intended that the saliva should be swallowed. He referred to the rare occurrence of expectoration on the part of ladies, and remarked that it was so unfrequent as to excite comment when a lady did such a thing in passing along the street. He believed that as much or possibly more was known of dental caries than of diseases generally. Too often what is regarded as a perfect acquaintance with and a complete description of any given disease, embraces merely a catalogue of phenomena, an intimacy with symptoms being mistaken for a knowledge of the disease, whose cause and true nature perhaps remain a profound mystery. Many of the so-called *causes* of disease are eminently hypothetical in their character. Much is said about malaria, a something which has a name, but whose real existence remains yet to be demonstrated by the physicist. Where is the microscopist who has seen it with a lens of the lowest or highest power? Where is the chemist who has demonstrated its existence even after the most careful, searching, and protracted analysis?

Dr. Sill did not regard the fact of a person enjoying remarkable health under the use of tobacco, as any argument in favor of the article. He invariably advised his patients strongly against its use.

Dr. Lusson cited an interesting case of a boy on his father's plantation in Cuba, who was in the habit of chewing tobacco and swallowing the saliva, as a remedy for attacks of epilepsy to which he was subject.

A MONTHLY meeting of the Odontographic Society was held on Tuesday evening, September 1st, at the rooms of the Philadelphia Dental College.

Called to order at half-past eight o'clock.

Vice-President, Dr. Kingsbury, in the Chair.

The minutes of the last meeting were read and approved.

The Executive Committee reported the following gentlemen as candidates for membership, and each upon separate ballot was elected:—

Active Member.—Dr. Chas. Sill, Pittsburg, Pa.

Corresponding Members.—Drs. C. W. Spalding, St. Louis, Mo.; Geo. Watt, Xenia, Ohio; W. B. Hurd, Brooklyn, N. Y.; C. R. Butler, Cleveland, Ohio; E. Saunders, London, England; W. A. Pease, Dayton, Ohio; W. W. Allport, Chicago; Joseph Richardson, Terre Haute, Ind.

Honorary Members.—Prof. Henry Morton, A.M., Philadelphia; Dr. B. Ward Richardson, London, England.

Several nominations were made, and the proposed names submitted for the consideration of the Executive Committee.

Donations to the library being in order, Dr. McQuillen said that, regarding it as a matter of the first importance for the Society to have a *good* library at the earliest period practicable, he had placed the bookcase, which the gentlemen saw in the adjoining room, there with the view of having it filled with books; trusting that the funds of the Society and the liberality of its members and their friends would soon enable them to effect the end desired. In addition to offering the case as a repository, he presented to the Society the following books: Dunglison's Human Physiology, 2 vols.; Miller's Principles of Surgery, 1 vol.

Dr. Kingsbury said that he wished to present the following works to the Society in the name of Mrs. Horace Wells, widow of the late Dr. Horace Wells, of Hartford, Conn.; upon a recent visit to that place he was intrusted with their delivery as a donation from that worthy and estimable lady, viz.: "An Examination of the Question of Anæsthesia, arising on the Memorial of Chas. Thos. Wells," by the Hon. Truman Smith, United

States Senator from Connecticut; "An Essay on the Teeth," by Dr. Horace Wells.

Dr. Flagg moved that the thanks of the Society be tendered Mrs. Dr. Horace Wells and Dr. McQuillen, for their manifestations of interest in its welfare. Carried.

The following paper was then read:—

"THE BLOW-PIPE."

BY WM. GORGES, D.D.S.,

DEMONSTRATOR OF MECHANICAL DENTISTRY IN THE PHILADELPHIA DENTAL COLLEGE.

The working of metals appears to have been coeval with Adam, and it is reasonable to infer that at a very early period of the earth's history the blow-pipe was used in that connection. Within the last fifty years, important and valuable modifications have been made in the instrument, through which, substances that are entirely unaffected by the action of ordinary heat can be reduced from a solid to a fluid condition with perfect facility. I refer, of course, to the great and inestimable discovery of the compound, or oxy-hydrogen blow-pipe, by the late Professor Robert Hare, of Philadelphia. For ordinary purposes, however, the more simple and primitive the pipe, the better. In this form it is not only a necessary, but an indispensable adjunct to the dental laboratory.

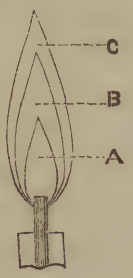
In entering upon the consideration of this subject, I propose, first, to consider briefly the phenomenon of *combustion*, as manifested in the flame of a lamp. *Secondly*, the various kinds of lamps and pipes which have been introduced for the use of the dentist. And lastly, the proper way to use the blow-pipe so as to secure the end desired; for much of the loss of time, patience, and confidence in one's ability to use the pipe, depends upon an imperfect knowledge or ignorance of the philosophy which underlies this, as it does all other operations in mechanics. Who has not experienced, even after a lengthened novitiate, the greatest vexation and fatigue, approaching almost to complete exhaustion, in attempting to solder a set of teeth requiring more than an ordinary amount of heat to fuse the solder? The greatest pains may have been taken to make a complete fit of the plate to the cast of the mouth, the teeth may have been ground and adjusted, promising the patient as well as the operator something superior in every respect. Alas! how great the disappointment, after removing the investing substance, to find teeth cracked, or drawn from the plate, or the plate itself warped, so as to render the piece useless for the purpose intended!—such accidents being not only embarrassing, on account of the non-fulfillment of the promise to the patient, to have the operation completed at a given time, but also involving sometimes quite a pecuniary loss. In the early part of my practice I found such accidents of common occurrence with others as well as myself, and therefore recognized the im-

portance of becoming thoroughly acquainted with the subject in all its bearings. If in my presentation of this matter you should regard some points touched upon as too elementary in their character, you must refer it to a desire on my part to awaken others to a necessity of becoming acquainted with the basal principles.

Fownes says that, "(in the most general sense,) a body in a state of *combustion* is one in the act of undergoing intense chemical action; any chemical action whatsoever, if its energy rises sufficiently high, may produce the phenomenon of combustion by HEATING THE BODY TO SUCH AN EXTENT THAT IT BECOMES LUMINOUS."

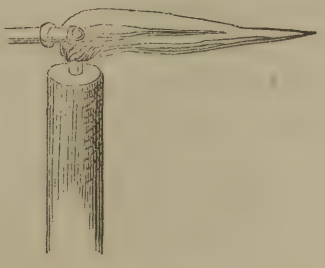
In the ordinary combustion of substances, it is an indispensable requisite that there shall be a due supply of oxygen brought in contact with the flame, or the action will cease. Combustion is therefore due, under these circumstances, to the union of an inflammable substance with oxygen, attended with light, and in most instances with heat. It is the latter consideration, or the elimination of heat, which is most interesting and important to us at the present moment.

Fig. 1.



With this object in view, it may not be amiss to direct attention to the well-known fact that the flame of a candle or lamp burning in the air is hollow, and that when carefully examined it is found to be composed of three distinct portions, as represented in Fig. 1. Their characteristic properties are as follows. The outer cone or envelope C gives forth very little light, but possesses a very high *temperature;* the cone inside of this, B, is highly luminous; while the internal portion A is dark, and composed of combustible matter. When a current of air is driven by the blow-pipe against a flame, the nozzle of the instrument being in contact with the flame, "two long pointed cones (Fig. 2) are observed in place of the double envelopes just described, the outer cone being yellowish, and the inner blue, a double combustion taking place by the blast *inside*, and by the external air." The space between the inner and outer cones is filled with exceedingly hot combustible matter, possessing great deoxidizing or melting powers. In the use of the blow-pipe it is a matter of importance to bear in remembrance the point where the highest elevation of temperature exists. It is

Fig. 2.



not an unusual thing to see a tyro ignorant of these facts blowing a blast of cold air on his work, by placing the nozzle of the pipe too far in the flame; for, paradoxical as it may appear, the instrument can be made to blow hot or cold.

The mouth blow-pipe is the instrument in general use, but I have discarded it for the following reasons. In studying the physiology of respiration, I was led to question whether air which is exhaled from the lungs will support combustion, for the air blown from the mouth must have been inhaled into the lungs to perform its part in sustaining organic life. Chemistry teaches us that atmospheric air is a compound gaseous body, composed of twenty volumes of oxygen to eighty of nitrogen, and is indispensable to organic existence. In performing its part in the animal economy, it undergoes a change; the oxygen is *absorbed*, and carbonic acid gas is *expelled*.

"There is a popular theory which declares respiration to be a process of *combustion* or *oxidation*, and it no doubt has caused many a reader a pleasant feeling of surprise when first informed that the burning of a candle, the rusting of iron, and the process of breathing were only three forms of the same process, three names for three different forms of combustion or oxidation. There is great satisfaction in such generalizations when they are true, and one regrets to find that sometimes they are not; this one is not. The burning of a candle and the rusting of iron are indeed two forms of one process of combustion: they are oxidations; but respiration can no longer be considered in any sense as a process of oxidation. Respiration as a process is twofold—the *exhalation of carbonic acid*, and the *absorption of oxygen*. The difference between the two processes may be summed up as follows: *combustion* is only *oxidation*, while respiration is not *oxidation*, but an *exchange* of gases. In the combustion of the candle, the oxidation is everything, and no process of exchange takes place. In the breathing of an animal, the exchange is everything, and no oxidation takes place. It is a well-known fact that if a lighted candle is lowered into a well containing carbonic acid gas, it is speedily extinguished."

The foregoing facts have induced me to regard the air exhaled from the lungs, loaded as it is with carbonic acid gas, as unable to support combustion, and therefore unfit to be used for the purpose of soldering. It may be said that the mouth-pipe has been used from time immemorial, and that the flowing of solder has been and can be readily effected by it. While admitting this to be the case, it does not militate against the correctness of my conclusions, that it is far better to use the blow-pipe with some apparatus by which atmospheric air may be employed in place of the air exhaled from the lungs.

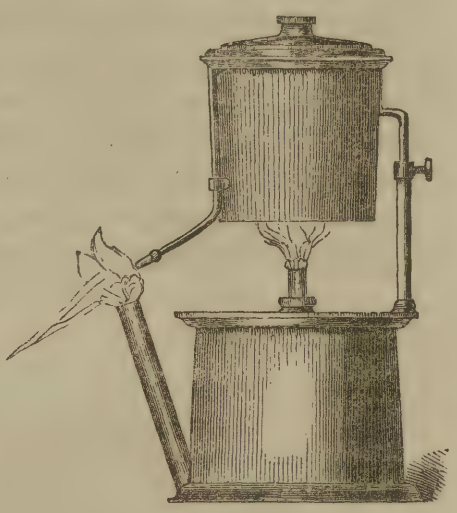
Various ingenious contrivances have been invented as substitutes for the mouth-pipe. The majority of these are on the self-acting principle,

in which the heated vapor of alcohol is driven by expansion from a reservoir or boiler through the pipe on a flame of the same substance.

A brief description of some varieties of these may not be amiss, as they have a direct bearing on the subject under consideration; and while they are familiar to many present, there may be some here and elsewhere who are not acquainted with them.

The first of these (Fig. 3) consists of a lamp made of tin, capable of holding half a pint of alcohol, having two wicks, over one of which a brass boiler, containing the same quantity of alcohol as the lamp, is suspended on an upright rod, the boiler being readily moved up or down the rod by means of a set screw; the second wick of the lamp is placed in such a position as to be in a direct line with the vapor of alcohol escaping from the boiler through the pipe. Two points can be attached to the pipe, so as to produce either a flaring or a pointed flame.

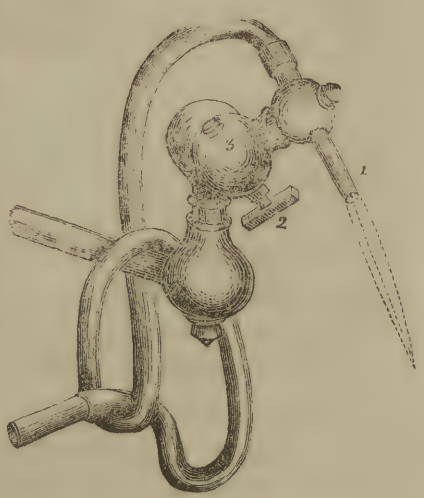
Fig. 3.



Another modification of this is formed by a boiler made of sheet-brass, supported on a sheet-iron frame, having a lamp underneath made of tin. This acts upon the same principle as the first described.

In each of these it will be seen that the lamp not only supplies a flame for the vaporization of the alcohol in the boiler, but also one in addition for the soldering. The next one to which attention is directed, however, known as Hollely's patent, is somewhat different. The boiler in this has a lamp underneath it for the vaporization of the alcohol, and another in front of the pipe to be employed in soldering. The pipe is so arranged as to allow the vapor of the alcohol to escape, by means of a faucet, through a large or small aperture at the end of the pipe, in this way producing either a pointed or flaring flame.

Fig. 4.

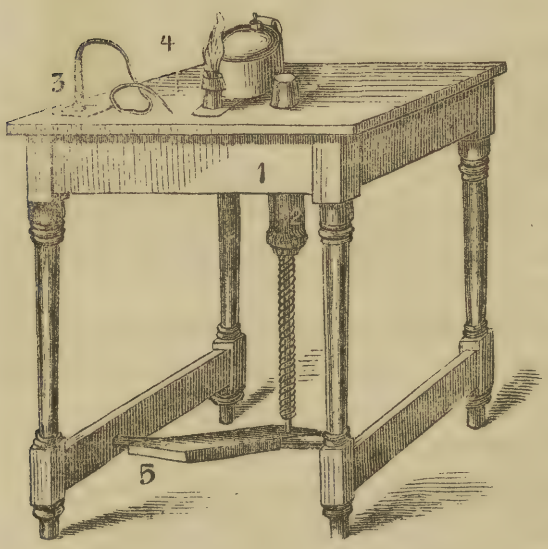


The Macomber gas blow-pipe (Fig. 4) is an ingenious contrivance, and is designed to be attached to a gas-pipe, employing gas in place of oil or alcohol. It may be described as follows: No. 1 is a double tube, or rather a tube

inclosing a tube, the atmospheric air being driven through the centre tube, adding force and giving a cylindrical form to the flame. No. 2 is a stopcock, by which the size of the flame may be regulated. No. 3 is a movable joint, by which the flame can be directed upward or downward.

The best arrangement for soldering, to my mind, is one which I have in use, made by myself. It is not only simple and inexpensive in its construction, but eminently efficient. It consists of a plain deal table, having connected with it a small bellows of the blacksmith pattern, sixteen inches long and nine inches wide at its broadest part. The nozzle of the bellows is connected with a long metallic tube which passes through the top of the table, where any ordinary blow-pipe is attached to it in a stationary and perpendicular manner. The nozzle of the blow-pipe is bent down at an angle of forty-five degrees. With an apparatus of this kind, the pipe being stationary, the operator has his hands entirely at liberty, as the bellows is worked by the foot.

Fig. 5.



A very satisfactory apparatus (Fig. 5) is employed by many practitioners, consisting of a table with an air-chamber 1, into which the air is driven by a force-pump 2, the latter being worked by a treadle 5, and spiral spring. The pipe 3 conveying the air from the chamber is so arranged on the table as to be moved about in any direction to meet the lamp 4, which can be placed in such position as may be demanded by the work in hand.

As a preparatory step, when engaged upon a case requiring soldering, I invert the set of teeth over a flame of ordinary gas, so as to heat it up gradually until the plate and teeth are brought almost to a red heat; then with the pipe I direct a broad flame on the work, steadily intensifying without reducing the volume of flame, until the soldering is completed, which can easily be done by adding weights to the top of the bellows. I never concentrate the flame to a focus on any one point of the work, or use what is called a pointed flame, believing that the alternate and sudden variations of temperature to which the operation is subject under such circumstances is the cause of the warping of plates and the cracking of teeth, so much complained of by many practitioners. These difficul-

ties are increased by the difference in expansion and contraction between the plate, teeth, and investing material. This last-named cause of trouble in soldering is a direction in which I propose to make some experiments, and will in a future paper give the results of my observations in detail.

Dr. Flagg said that he had heard of the proposed subject with convictions that it would combine interest with practical utility to a very marked extent; but he was even more than confirmed in his opinion at viewing the extended field which had been opened by the paper just presented. For himself, he had never reduced the act of using the soldering-lamp and blow-pipe to anything which might be termed scientific in its application; but he fully appreciated that the paper took cognizance of truth, which he had learned experimentally to be of the utmost practical value.

There was one point, however, which he felt disposed to combat, if it were only for the sake of further eliciting argument to substantiate the correctness of the position assumed; and that was the unfitness of the air from the mouth blow-pipe for the purposes of combustion. He acknowledged that an improper, injurious, and almost impractical use of the blow-pipe would give rise to the objection; and he would admit that he had often seen those employing it inhale a full inspiration through the nose or mouth, or perhaps both, and exhale through the blow-pipe the air thus obtained. He regarded this as an *abuse* rather than a use of the valuable instrument under consideration.

A proper employment of the muscles pertaining to the throat and palate to drive the air into a chamber formed by the cheeks, and closed posteriorly by the tongue acting as a valve, and the use of the natural elasticity of the buccal tissues to compress such air with the degree of force required, constituted the secret of successful and easy use of the mouth blow-pipe. This need not, and *should not*, interfere in the slightest degree with the even, natural inhalation and exhalation through the proper channel of the nares.

He wished at this time to call the attention of the members to the peculiar form of soldering-lamp which he had in use in his laboratory, and which he thought combined many requisites pertaining to a portable lamp. The lamp consisted of an *oblong*, square body, at one end of which was soldered a small tube; this, projecting from quite near the bottom of the end, was attached to an upright tube of an inch in diameter, which contained the wick. The objects gained were three in number: first, safety, from impossibility of explosion; second, diminished danger from upsetting when elevated on account of decrease of oil or alcohol; third, the advantage of gaining a *head* of fluid by slight elevation. The attainment of these requirements was demonstrated.

Dr. Wardle said he was not much in favor of the mouth-pipe, and never

could avail himself, in a *scientific* manner, of the principle spoken of by Dr. Flagg.

Many years ago, he was making a piece of work for the late Dr. E. Townsend, which was both difficult and delicate to solder. A friend seeing the exhausted condition of the operator, insisted upon his inventing something better than the mouth blow-pipe. He made a pair of tube-bellows, and found them to work very well. Afterward made similar ones for a number of dental friends; among the number, he made a pair for Dr. S. S. White, from which he supposed the air-pump soldering apparatus originated which is made and sold by that gentleman. Found that he could improve the bellows by inserting a tin chamber in the body of the table, in which to compress the air, and thereby produce a constant, steady current of air. At that time, he did not desire anything better for soldering purposes. On account of changing his laboratory, laid them away for the want of a snug corner to place them in. Then tried "Shaw's Artisan;" but found steam, fire, and teeth too much to attend to in connection with soldering a difficult piece of work. Now uses the bellows again, with a slight alteration of the blow-pipe which belonged to the "Artisan," with Shaw's heater, thus keeping up two gas flames on the work during soldering, of which he has perfect command; and thinks he has the "ne plus ultra" of a blow-pipe for dental purposes.

He observed that the flowing of metal was more mellow when the mouth-pipe was used. He attributed this to the moisture of the breath, which he also learned was the case when steam was thrown into a stack of metal at the foundry.

Dr. Kingsbury remarked that the subject of the essay—the blow-pipe—was invested with special interest; and it was not to be wondered at that some of the members were quite eloquent, and waxed *warm* in the discussion of it. At the time he was initiated into the mysteries of the dental laboratory, the plain mouth blow-pipe was in general use. The first improvement on that was in the shape of a bulb, equidistant from each end, to arrest and hold the vapor of the breath and superabundant saliva that the exhausted and almost distracted blower was apt to force through the pipe on his work. But even with that improvement, he always regarded it as a most laborious and unsatisfactory instrument.

The eolipile or self-acting alcoholic blow-pipe was certainly a great acquisition to the dental laboratory. The first instrument of this kind that he ever saw or had any knowledge of, was at the office of Dr. Horace Wells, in the City of Hartford, Conn., in 1839. He explained it, and demonstrated its practical value. From him he procured a copper globe and pipe, brought them on to Philadelphia, and had the instrument

completed by Mr. Warner, an artisan who resided for many years in Merchant Street, and who was widely known to the members of our profession in those days as a man skilled in the manufacture of gold and silver plate and wire for dentists' use, and possessed of a valuable *secret* in *doctoring* gold clippings and filings. The instrument proved a most efficient one, and was used by him for many years with great satisfaction. It was in all essential points similar to the instrument of more modern construction, having a safety-valve to guard against accident.

It was but a short time after this that, on visiting Mr. Warner's shop, he saw a number of these blow-pipes; and their adoption by the profession soon became quite general. He did not claim for his esteemed relative, the late Dr. Horace Wells, who, as you all know, was the *true* and *acknowledged* discoverer of *anæsthesia*, the *invention* of the self-acting alcoholic blow-pipe; but there was no doubt that its modification and adaptation to the dental laboratory was due to him. He stated to him (Dr. K.) that he got the idea from a blow-pipe of much larger size, but of similar construction, that was in use in the chemical laboratory of Washington College, now Trinity College, of Hartford; and his perceptive and inventive genius at once led him to appreciate its adaptation and value for dental purposes. He deemed it no more than justice to the friend of his early years to mention these facts, and to make these remarks.

This instrument was used by Dr. K. until 1846, when he met with a fancy English glass-blower, who had a pneumatic blow-pipe, the action and economy of which struck him as just the thing for the dentist's laboratory. According to his statement, it was the joint invention of himself and the celebrated Dr. Lardner. Whether the genius of that truly scientific man was concerned in it or not, he could not vouch; but the apparatus was one of the most simple and effective he had ever met with. It was inclosed by woodwork, so that the secret of its construction could not be obtained without the consent of the owner, who fully appreciated the value of the apparatus, and was not at all inclined to reveal its mysteries for the public good.

After conciliating his favor by the purchase of a number of his wares, he consented to show his blow-pipe, and explain its mode of operation. Dr. K. soon had one constructed, had used no other kind of blow-pipe since, and could not desire a better one.

The lateness of the hour forbade a detailed description of it on that occasion. He would perhaps at some future time furnish a particular description, with drawings for the benefit of the profession. He would, in the mean time, be happy to show the one he has in use to any member who felt disposed to call at his laboratory and examine it.

Dr. McQuillen said, he fully concurred with Dr. Gorges in the opinion that much valuable time was lost and materials destroyed by students and practitioners from the want of a proper knowledge of the scientific principles involved in the employment of the blow-pipe.

Many persons, from an ignorance of the process by which *respiration* is effected, appear to be incapable of learning how to drive a continuous current of air from the mouth through the blow-pipe; and yet nothing was more easy when the difficulties are once surmounted than to do it for quite a long period, and with little or no fatigue to the person engaging in it.

In such operations, it was necessary to remember that *respiration* is divided into two acts—*inspiration* and *expiration;* and all that was required when using the instrument was to learn to make *full, deep, and rapid inspiration* through the nostrils without taking the pipe from the mouth, and then to drive the air, in the act of *expiration*, gradually but forcibly through the pipe on the flame, alternating these acts in a calm, regular, and methodical manner. It generally required time, patience, and many trials on the part of the novice in learning to use the instrument; but the difficulties once removed, if others felt as he did, they would rather enjoy the operation than otherwise.

He was decidedly favorable to the use of the mouth blow-pipe, and regarded its employment as beneficial to the dentist, for the following reasons: The exercise increases the *capacity* and volume of the lungs, and by the *forcible inspiration* and *expiration* of air which takes place under such circumstances, an opportunity is afforded to drive out or exchange a large portion of what is denominated by physiologists *residuary air.* The *capacity* of the lungs means, according to Mr. Hutchinson, "that quantity of air which an individual can force out of his chest by the greatest voluntary expiration after the greatest voluntary inspiration." This author, who had paid considerable attention to the subject, had found that "the mean capacity of 172 males, under the height of five feet eight inches, was 220 cubic inches; while that of 82 males, from five feet eleven inches to six feet, was 255 cubic inches. For every additional inch of height, (from five to six feet,) eight additional inches are given out by a forced expiration."

The lungs were never completely emptied of air, even upon the most violent expiratory effort; and the remaining portion is therefore denominated *residuary air.* It is upon the presence of this air that the lightness of the lungs depends, which enables them to float upon water. The hydrostatic test of infanticide was also based upon this circumstance, for no mechanical or other power can dislodge the air from the organs after they have once been distended by a full inspiration.

While recommending the employment of the blow-pipe as an excellent means of exercise for the lungs, if required to use it a great deal, he might prefer some other apparatus. With regard to the distinction between *combustion* and *respiration*, there could be no doubt that in *combustion* the *oxygen* was *burned up*, while in *respiration* an *exchange* of gases merely takes place, *oxygen* being *inhaled*, and *carbonic acid gas exhaled*. It was formerly asserted that the lungs served as a furnace to the body, and that the oxygen absorbed during inspiration was rapidly burned up there, and the heat thus generated was distributed to every part of the system. A more fallacious or unphilosophical theory could hardly have been advanced. *Combustion*, it was true, did take place in the lungs; but not to a greater extent there than in other parts of the economy. Calorification, or the warming of the body, was due to the fact that the *oxygen* absorbed by the lungs during *inspiration* was distributed by the arteries and capillaries to every part of the organism, and there coming in contact with the broken-down tissues or *carbon*, a chemical union takes place, and carbonic acid is formed, resulting in the liberation of the latent caloric resident in each element, upon the principle that when two elements are brought together having an affinity for each other heat was evolved.

The theory advanced that the air exhaled from the lungs was unfit to be used with the blow-pipe, on account of the carbonic acid gas present, was quite plausible as an argument; but to what extent it was tenable as a fact, he could not pretend to say.

Dr. Lusson uses the blow-pipe of Dr. Calvert, the peculiarity of which consists in having a supply of gas enter midway of the pipe, which is ignited at one extremity, and supplied with additional oxygen from the other by means of the lungs, as in the common instrument. He considered it preferable to any blow-pipe he had ever seen or used. From the breadth of flame the work is readily heated, and the liability of cracking of the teeth very much diminished; besides, the difficulty of discovering exactly the proper point for directing the current in the use of the ordinary pipe is here entirely obviated.

Dr. Neall uses a force pump in connection with the pipe.

Dr. Flagg moved that the various kinds of blow-pipes be exhibited, and a practical demonstration of their principles given at an adjourned meeting, to be held on Tuesday evening, September 15th. Carried.

Adjourned.

An adjourned meeting of the Odontographic Society was held on Tuesday evening, September 15th, 1863, at eight o'clock.

Vice-President, Dr. Kingsbury, in the Chair.

Dr. Gorges, the essayist of the previous evening, gave a practical demonstration of the various blow-pipes treated of in his paper, the different apparatus having been kindly furnished by Dr. S. S. White, in compliance with the request of the Society.

Dr. Lusson also exhibited the gas blow-pipe of Dr. Calvert's pattern, which is designed to heat and solder the work by separate flames. Being provided with two burners, the high temperature of the work is maintained independent of the blowing necessary for soldering.

Prof. Morton said that in the ordinary alcohol blow-pipe, the explanation of its utility is as follows: The jet of alcohol vapor rushing into the flame of the lamp, carries with it a draught of air, so hastening the combustion by a freer supply of oxygen. Where air is driven through the flame by the mouth or table blow-pipe, the same effect is more directly reached.

The apparatus already in use leaves nothing to be desired in the ingenious adaptation of parts. If it is desired to produce a greater heat than may by these means be developed, we must call to our aid more powerful agents than alcohol and air. These have been introduced in the oxy-hydrogen blow-pipe. Here, in place of alcohol, we burn the far more combustible substance hydrogen gas, and in place of air, (which contains but one-fifth part of oxygen, the remainder being nitrogen, which does not aid the combustion, but, on the contrary, cools down the flame by its presence,) we drive into the flame pure oxygen gas.

As early as 1802, Dr. Hare had published a memoir explaining the rationale of the heat developed by the union of the elements of water, the means of burning them without danger, and the intense character of the light and heat which might be so developed.—(*Tillock's Philos. Magazine*, London, vol. xiv., and *Annales de Chimie.*) These memoirs were accompanied each by a plate representing the apparatus. Subsequently, in 1817, an account was also published by him of the fusion of strontia and vaporization of platinum.—(First part, sixth vol., *Amer. Phil. Transactions.*) This apparatus was used by Mr. Rubens Peale in his father's museum for ten years between these dates.

Professor Silliman published in May, 1812, in *Tillock's Magazine*, a memoir of many important experiments performed with this apparatus of Dr. Hare, which he says "has been in common use for class experiments in Yale College for eight years."

In 1819, Dr. Clark, of Cambridge, published a book entitled *Clark's Gas Blow-pipe.* In this he ignores Hare's publications,* and claims all

* With the exception of a slighting reference to the memoir in the *Annales de Chimie.*

the credit for himself and a Dr. Thompson, of Glasgow, who, according to his own showing, only contrived to blow up his apparatus in some futile attempts in this direction in 1802, the date of Hare's *publication*, his apparatus and experiments being made a year before. Clark used the mixed gases compressed into a strong metallic vessel, explosion being avoided by safety tubes.*

At the same time, there was published by Dr. W. Henry, F.R.S., Vice-Pres. of Lit. and Phil. Soc. of Manchester, etc., a work on chemistry, in which he refers to Hare's essays; but speaks of Clark as having improved the apparatus and obtained better results, citing the vaporization of platina as an example, though this had been accomplished and published by Hare twelve years before.

This apparatus of the above-described parentage consists of a double concentric nozzle—that is, of a small pipe inside of a large pipe. From the outer pipe, hydrogen escapes and is ignited; and when the oxygen is turned on to the inner pipe, it escapes in the centre of the hydrogen flame, so supplying it with this best supporter of combustion, and causing it to develop its greatest possible amount of heat.† The intensity of this heat was then shown by the fusion of platina, the cupellation of silver, and the burning of iron, copper, etc. The adaptation of this intense flame to the production of light, by causing it to impinge upon a cylinder of lime, was then exhibited, and some of its practical applications were described and illustrated. Thus, its utility for the display of microscopic sections and specimens, as well as diagrams and photographs, was practically demonstrated, as also some of the pleasing effects produced by the so-called stereopticon. Lastly, its application for the production of the ghost exhibitions, at present so popular, was explained, and a ghost of similar character introduced.

After this entertaining and instructive exhibition, upon motion, a vote of thanks was tendered Prof. Morton for the opportunity so kindly afforded the Society of observing his valuable and scientific experiments, for the interest manifested in its favor, and the trouble incurred in the preparation of the evening's entertainment.

Dr. McQuillen read a letter which he had received from Dr. N. W. Kingsley, of New York, that morning, (in response to one which he had sent a few days before,) stating that he had anticipated being present at the meeting, but circumstances had prevented. He therefore moved that an invitation be extended by the Society to Dr. Kingsley to be present

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* A very dangerous process, notwithstanding, which has led to some fatal accidents since his time.

† The gases are supplied to both tubes or nozzles from gas-bags or other forms of gas-holders.

at the next monthly meeting, October 6th, and favor the members of the Association with a detailed description of his "artificial velum," together with the various appliances necessary for its construction. The motion was unanimously adopted.

On motion, the meeting adjourned.

A MEETING of the Odontographic Society was held on Tuesday evening, October 6th, 1863, at eight o'clock.

President, Dr. Kingsbury, in the Chair.

On motion, the regular order of proceedings was suspended, to enable Dr. N. W. Kingsley, of N. Y., to address the meeting, with the design of describing his "Artificial Velum," and demonstrating the method of its construction, from the taking of an impression to the introduction of the apparatus.

Dr. Kingsley commenced his remarks direct on Congenital Fissure of the Palate, by referring to the two methods of treatment, viz., uniting the parts by suture, or by filling the fissure with a mechanical appliance. He was strongly opposed to the surgical operation, on the ground of its being painful and unreliable, and, even when success was attained by a perfect union of the parts, all experience shows no *very marked* improvement in the speech followed; experience also proves that any other inconvenience resulting from the deformity other than its influence on speech is so slight as to be of no serious annoyance to the patient. Difficulties of deglutition with a fissure of the velum, and corresponding benefits arising from a union of the parts by suture, are so slight as, in his opinion, to make the operation wholly unnecessary.

The only necessity of operating at all is with a view of benefiting the speech. A grand distinction must be made between the speech and the voice. In fissure of the palate the vocal organs are perfect, the organs of speech are not. Voice is natural; speech is mechanical, and the result of association and education. In making speech out of voice the perfect, natural velum acts as a valve to direct the voice through the mouth, or through the nares, thus modifying it, and in connection with other organs making of it different sounds which come to be understood as speech. In a cleft palate the power to direct the voice is in a great measure lost, and speech is necessarily imperfect.

In a complete union of the parts by suture, the septum thus formed, in nearly every case, is so rigid and inflexible as to be without the power of controlling the direction of sound, and the speech is necessarily but little, if any, improved.

He illustrated these remarks and demonstrated these positions by diagrams on the black-board, and by a drawing of a supposed musical wind instrument, in which the analogy to the vocal tube was strikingly shown. He believed the only operation which promises real benefits to be the adaptation of an elastic artificial velum to the fissure, so soft as not to injure the surrounding tissues, so firm as to keep its place, and so flexible as to be controlled by the muscles in contact with it. An instrument possessing these qualities will render it perfectly possible for the patient to learn to speak well.

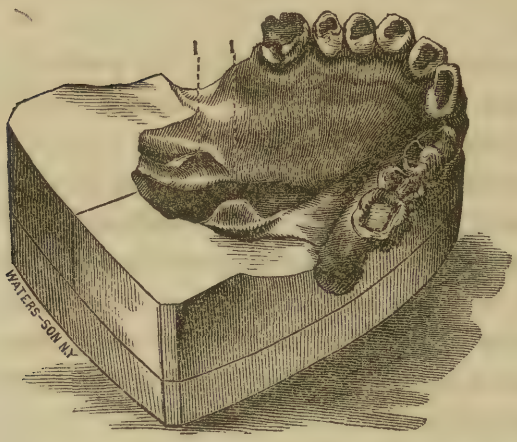
The metallic obturators, and all other appliances to plug the posterior nares in cases of congenital palatine fissure, are simply useless. It is physically impossible for perfect speech to follow their use.

In reply to some inquiries, he described his method of working plaster, and parting plaster casts from plaster moulds, which, although not altogether original, is but seldom practiced, and is far superior to the plan generally followed by dentists. By having a creamy solution of soap, in a vessel large enough to immerse the impression for a minute, and then wash off all the soap on the surface, a beautiful model will be obtained, which will separate readily and perfectly.

After these general remarks upon the subject, noting the almost total uselessness of such obturators as have been hitherto introduced, the admirable and wonderful accuracy of speech which may be acquired by perseverance with a well-adapted elastic artificial velum, and drawing a distinct and pleasing outline between *voice* and *speech*, remarking that in cases of fissured palate the former is perfect, while the latter is so defective as to offer almost total defiance to the comprehension of a stranger, he proceeded with an accurate description of the manipulation necessary for the construction of the apparatus, assisted by models, diagrams, etc. He stated that the first, most difficult, and probably most important step in the whole operation is the procurement of an accurate impression, which must embrace a perfect cast of all the boundaries of the fissure, together with the parts above and below its margin. The delicacy and irritability of the surrounding tissues render it necessary to establish a tolerance to the presence of a foreign body, such as plaster; this is accomplished by handling the parts, and bathing them with some slightly astringent wash several times a day; the first impression should extend but a short distance back, the second somewhat farther, and thus, by a gradual encroachment, together with the other preparatory measures, the impressibility will be so much diminished as to admit, after several sittings, of taking a full and perfect impression with the manifestation of little or no inconvenience. Plaster he regards as by far the best substance for this purpose, for since so little pressure is necessary in its introduction, the

position of the soft structures remains unchanged, and a perfect impression is obtained of them in the normal position. To introduce and remove the plaster with facility, and, at the same time, secure a perfect result, requires the combination of skill and experience; it should be withdrawn as soon as it is sufficiently solidified to retain its form, when the upper portion will separate at the edge of the fissure, and may be removed by sliding posteriorly. *Fig. 1, a sectional plaster model of a case of fissured palate, 1 1, the two prominences at the posterior border representing the remnants of the uvula. When the operation is so far advanced as to have obtained a satisfactory cast, a model velum of sheet gutta-percha or any other plastic substance should be moulded upon its surface with great nicety, and in such form as the permanent apparatus is designed to assume; this must be duplicated in hard rubber, which appliance may be cut, and otherwise altered until perfect, when it must be reduplicated in an elastic and serviceable material; experiment has demonstrated *elastic* vulcanized rubber to be the only substance which possesses the properties requisite to constitute an apparatus whose movements shall closely resemble the actions of the natural parts, perform their functions, and be retained in position without annoyance. The flexibility of the velum permits its compression by the muscular action of the lateral soft tissues, and insures its resumption of the original form as soon as the pressure is removed. To provide for this contraction of the posterior portion of the fissure, it is necessary that the velum should be constructed at the back part of two laminæ, one sliding over the other, or simply slit, with a third piece, or flap, to cover the opening, and prevent the escape of air through the nares. Fig. 2 represents the former, A A being the laminæ; B B, two bows of rubber continuous with the instrument passing through the slot C, and connecting with the lower layer; D D, the anterior portions of the superior alæ; E, one of the inferior alæ. A velum, consisting of three pieces at the posterior part, is shown in Fig. 3, being a view of its inferior surface. A A, the posterior edges of the lateral pieces; D, one of the superior alæ; E E, the

Fig. 1.



* For the illustrations we are indebted to Messrs. Lindsay & Blakiston.

inferior alæ; F, the flap covering the slit, retained in position by two bows, like B B in Fig. 2.

Fig. 2.

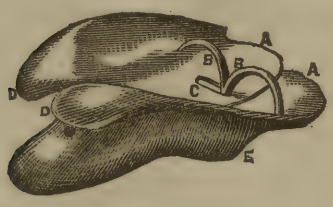
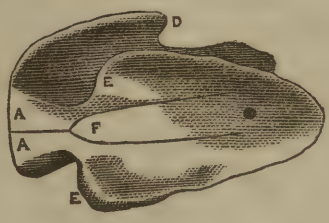


Fig. 3.

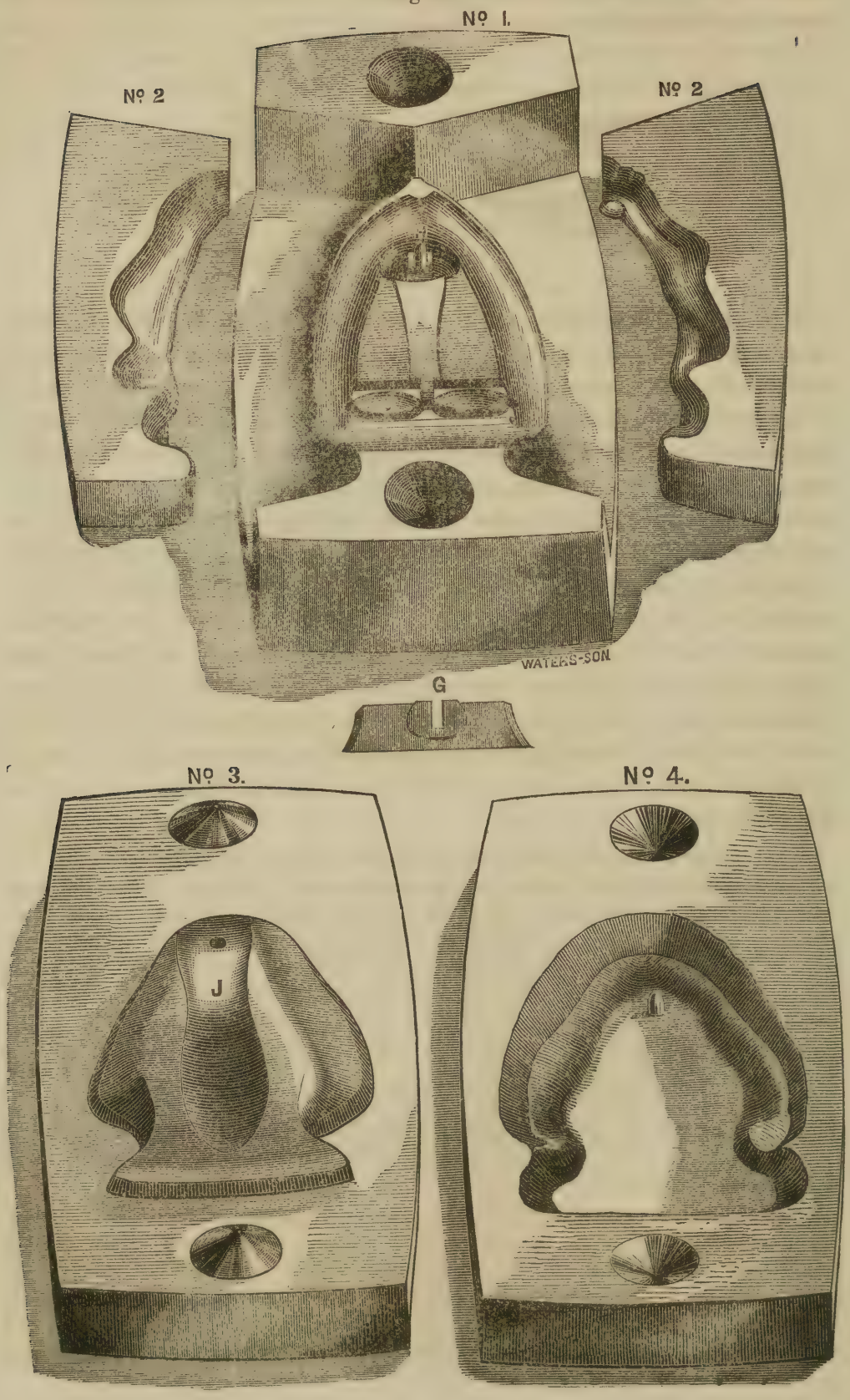


Having obtained a perfect fit in hard rubber, plaster should be moulded in sections upon its surface; the model thus obtained will not answer, however, for vulcanizing the final instrument, as the minute inequalities in its surface will produce similar imperfections in the rubber, which cannot be removed, and which, if allowed to remain, will interfere with its usefulness. It therefore becomes necessary to obtain from the plaster mould one of type metal, which presents a fine smooth surface, and may be retained for the manufacture of any number of vela. The rubber which is used for this purpose differs from the ordinarily prepared rubber; it vulcanizes with the desired elasticity in a steam heat of four hours, gradually elevated from 230° to 260° Fahrenheit. The following models and their descriptions are taken from the last edition of Harris' Dental Surgery. The article upon this subject was prepared by Dr. Dwinelle, and subjected to Dr. Kingsley's inspection before publication; consequently we can do no better than present his explanation of this intricate portion of an intricate subject.

"Fig. 4 shows the type metal mould. This mould is for packing and vulcanizing an elastic velum of three divisions. No. 1. Main piece or base of mould. The small block G is adapted to the mortise in the base also marked G. When in position, there is an opening through the centre of the block, and a groove from this opening passing out each side from under the block. This groove provides for forming the double arched bow as seen in Fig. 2. The pin H provides for a hole in the velum by which it is connected with a plate in the mouth, which assists in its support. No. 2. Two side blocks. No. 3. Top piece of mould with a depression J, to form the flap of the velum. No. 4 is used in connection with No. 3, to mould the flap separately, and afterward transfer it to No. 1. No. 5. Top piece to mould; but without depression to form the flap, as in No. 3.

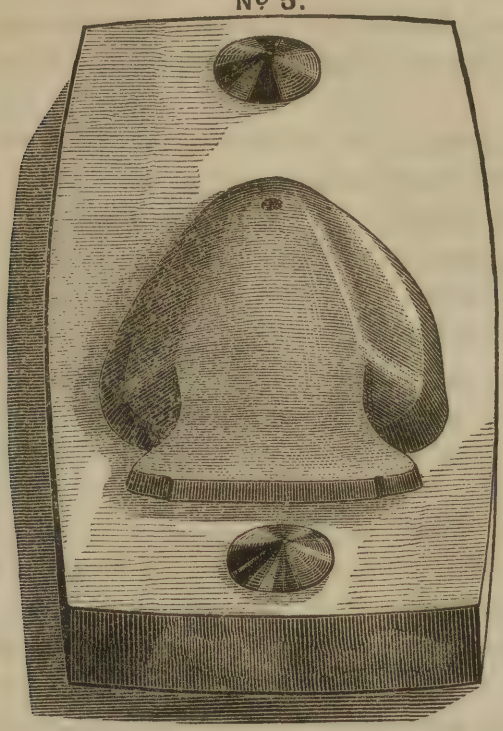
"To pack a velum, elastic rubber, peculiarly prepared for this purpose, must be used. Cover with a solution of soap, all that part of the mould which will come in contact with the rubber, which will prevent the rubber from sticking to it when vulcanized. Put the side blocks No. 2 in place, and pack the space with rubber until filled. Put on top piece No. 5, and warm the mould, and press it together with strong clamps. Cool off the

Fig. 4.



mould and open; if imperfectly packed, add more and press again. In the mean time pack the depression J, in No. 3, with rubber, using No. 4 to press it into shape. Remove top piece No. 5 from the mould, and put No. 3, containing the flap, in its place, previously slitting the body of the

Fig. 4.
No 5.



velum, from the posterior end to near the apex, and put a slip of paper into the slit to prevent a union in vulcanizing. Put also a piece of paper under the flap for the same purpose, permitting the flap to unite at the forward end with the body of the velum."

By a very simple contrivance, such as presented in Fig. 5, a full upper denture is attached to a velum, and worn with great comfort. It consists of a gold tube, No. 1, grooved upon one side, which is secured to the velum; a rod of the same metal, No. 2, provided at its upper end with a slight projection, is fastened to the artificial case, and this being passed into the tube and turned, firmly unites the two pieces of apparatus, admitting of their easy introduction and removal thus connected. When, however, teeth are present, it is necessary to make some attachments by clasps, in order to prevent the velum from slipping backward, as the fissure is mostly much wider at its posterior than at its anterior portion.

Fig. 5.

The subject was handled in a clear and masterly manner, indicating the

expenditure of much valuable time, labor, and thought in bringing it to its present perfection, and manifesting a thorough acquaintance with this specialty in all its bearings. He exhibited models of cases which he had introduced—the beauty and perfection of his plaster casts eliciting special comment as the results of educated, dextrous, and delicate manipulation.

Dr. Wardle moved that a vote of thanks be tendered to Dr. Kingsley for the admirable description which he had just given of his excellent apparatus.

Dr. McQuillen offered, as an amendment to Dr. Wardle's motion, that a committee of three be appointed to prepare a suitable testimonial to be presented by this Society to Dr. Kingsley in acknowledgment, not merely of the valuable improvement made by him in the artificial velum and palate, but also on account of the high stand taken by him in giving freely to his fellow-practitioners the result of his labors, in place of holding it as a secret, or adopting the course pursued by too many of patenting any small affair which by accident or design they may happen to introduce to the notice of the profession. A gold medal was suggested as an appropriate testimonial.

The motion and amendment having been agreed to, the Chair appointed Dr. McQuillen, Professor Morton, and Dr. Flagg a committee to attend to this matter.

Dr. McQuillen said he could not permit the opportunity to pass by without saying that the verbal description of the apparatus, which they had just listened to, had given him a clearer idea of the importance and value of the improvement than he had been able to realize from the written description, and it would afford him additional satisfaction to have an opportunity of seeing the apparatus in use; the lucid and detailed account presented, however, left no doubt in his mind of the practical benefit that must accrue to the speech of those who may need and employ such an instrument. He was pleased with the nice distinction which had been made between *voice* and *speech*. He then referred to the defects which persons often labor under in speaking, and the necessity of correcting them by a course of elocutionary training under competent instruction. He instanced the case of Demosthenes, whose first efforts as an orator were of such a character as to offend the nicely-cultivated ears of the Athenians to such an extent as to induce them to drive him from the rostrum. His praiseworthy and successful efforts in overcoming the impediment under which he labored were well known. In these cases, it is true, the parties did not labor under the misfortune of having a fissure in the palate, but were merely required to correct a mental defect manifested in a precipitancy of utterance, denominated

stammering. Persons who are so unfortunate as to have a palatine defect, and from childhood have spoken under such circumstances, would be compelled, of course, to put themselves on a systematic course of training after the introduction of the most perfect velum, to secure distinct articulation. Taking these facts into consideration, it was reasonable, therefore, to infer that however imperfect the speech may be in cases of congenital fissure, that with such an admirable fixture as the one presented this evening, distinct articulation could be acquired by care and attention on the part of the unfortunate person.

Dr. Flagg said that he desired, before the adjournment, to call briefly to the minds of members that phase which a portion of the remarks of Dr. Kingsley had presented prominently to himself. He had during the past eight or ten years of practice devoted himself particularly to the study of those conditions which, presenting for the consideration of dental practitioners, had, for a marked concomitant, *pain*. It had been his endeavor to institute such mode of treatment as would insure alleviation from such suffering, and accomplished the result by methods of manipulation, or applications of remedial agencies painless in their action. He urged that the practice of dentistry could, and should be, divested of all those *inflictions* which were of such universal experience as to be regarded by many of the community as the *necessary accompaniments* of dental operations, and desired that every true dentist should take especial trouble to so *preach* and *demonstrate* by his works as to disseminate the truth that dentistry was a medium through which, in proper hands, might be offered not only almost immediate relief from the various forms of odontalgia, without resort to the dreaded operation of extraction, but, on the contrary, by means devoid of pain; that sufferers from toothache ought to be educated in the knowledge that the dentist was their best friend, and that at his hands, comfort could easily and surely be obtained. He regarded the domain from lips to pharynx as belonging to the dentist, and held to the opinion that all disease or deformity which pronounced itself in that locality, whether proceeding from local or constitutional causes, *ought* to be *best* treated by practitioners of the dental specialty; among these, that condition which to the general surgeon indicated a staphyloraphic or staphyloplastic operation, most certainly was included. But he wished to be distinctly understood as not desirous of *transferring* the performance of those operations from the general to the special surgeon, but to urge their almost entire abandonment by both. He would inquire, in a few words, what end was to be gained by their performance? Was it improvement in deglutition? He had repeatedly and universally been informed by patients, representing even the most extended instances of congenital

fissure, that there was no difficulty in this direction, either with solids or *fluids*. Then why attempt improvement? Was it to improve articulation? He had *seen* nothing but failures in this direction; and had it from practitioners of eminence, that their results in the perfection of speech amounted practically to nothing. It was well known to the gentlemen present, that the operation was a painful and difficult one; that denial from speech, food, and even the act of deglutition, must be practiced for several days; that it very often was entirely (*so called*) unsuccessful; that is, union of the parts was not obtained; and that, in his opinion, for the most part, these should be regarded as the operations resulting in the greatest good to the patients!! for, with this result, they were still left in a condition which, if the remarks of their New York friend were well based, could be so acted upon as much to improve the articulation without interfering with the deglutition already good; a result which it was impossible to obtain if "union" ensued from staphyloraphy, until that union was again destroyed by the knife. He thought this subject was one for serious consideration on the part of any one who proposed inflicting upon one of his fellow-creatures so much suffering, with the constant evidence of the obtaining, *at best*, such a deplorable result.

Adjourned.

An adjourned meeting was held on Tuesday evening, October 13th, 1863, at eight o'clock.

Vice-President, Dr. Kingsbury, in the Chair.

The minutes of the previous meeting were read and adopted.

Dr. McQuillen presented a number of letters which he had received from gentlemen residing in various parts of the country, who had been elected corresponding members of the Society; all of them acknowledging the pleasure with which they accepted the appointment, and expressing a warm interest in the organization; among others was one from Dr. C. W. Spalding, of St. Louis, Mo., in the course of which he refers to the importance of making *thorough* explorations of the mouth as follows:—

"Allow me, just for a moment, to call your attention, and that of your Society, to the subject of making examinations of the teeth, and of giving subsequent professional advice.

"So far as I know, a large portion of the dentists in this country are in the habit of giving such counsel and advice gratis; and, as a consequence of the service being rendered gratuitously, it is generally hurriedly and imperfectly done. How often do we find cavities, by no means small, that must have been overlooked at an examination made not many months before, either by ourselves, or by some other reputable practitioner!

"It is no small task to thoroughly explore a full denture, and determine whether any, and if any, what operations are necessary at this, or will be at any subsequent time.

"Now, it strikes me that this practice, now so prevalent, is all wrong, and that it is quite time it was corrected. When an examination is to be made, I say, take sufficient time; do the work thoroughly and well, and then charge a reasonable sum for the valuable service you have rendered your patient. Such services can only be rendered by a competent professional man. They are valuable, and a fair remuneration for his time and skill is no more than his just due.

"Why will not your Society help us in taking a step in the right direction, in endeavoring to correct this error?

"I might say much more in elucidation of the subject, but all that I could say, and more, will at once suggest itself to the minds of your members, at the bare mention of the topic."

The following paper was then read:—

"ANÆSTHESIA."

BY DR. AMBLER TEES.

A humane and sympathetic surgeon is always desirous of performing the duties of his calling with the least amount of pain consistent with the perfection of the operation, and the well-being of his patient. As the pain attendant upon close contact of the scalpel or lancet with nerves, tissue, and blood-vessels is often agonizing, it is not to be wondered at, that for ages the minds of physicians, surgeons, and scientific men have been dwelling upon the means of destroying the sense of feeling of a fellow-creature, while undergoing surgical treatment; and not until the present century has success attended the efforts made in this direction.

That our forefathers hoped and longed for the discovery of anæsthetic agents, we have ample proof. I have seen a book published in London about two hundred years ago, containing a comic poetical illustration of this subject; this was republished in the *Dental Monitor* in 1855. I crave your indulgence while reading it, not because it contains many very brilliant gems of thought, but because it shows how many years and even centuries may pass before experiment or accident reveals certain objects or ends sought for,—and because it proves that *all* inventions cannot be originated to order.

Anæsthesia is accomplished: first, by the inhalation of nitrous oxide gas, ether, or chloroform; second, by electro-magnetism; third, by local appliances.

Nitrous oxide or the peroxide of nitrogen, sometimes called from its peculiar effects *laughing gas*, is manufactured by decomposing nitrate of ammonia. The latter substance is subjected to a heat of 500° in a retort. It is resolved into water and nitrous oxide, one atom yielding three

atoms of water and two of nitrous oxide. The water condenses in the neck of the retort, and the nitrous oxide is received in a pneumatic jar. It has a sweetish taste, is colorless and transparent. When breathed it is very rapidly dissolved in the blood, and carried by the circulation to every part of the body, oxidizing everything in its path, and producing transient intoxication. It is necessary to inhale it about two minutes to effect insensibility to pain. This will last about two minutes more, when it requires a repetition of its inhalation for further operations.

This gas is exciting a great deal of attention at the present time among the dental profession, as it is said to be perfectly harmless, and unattended with the unpleasant influences and effects very often arising from the inhalation of ether or chloroform. The apparatus for manufacturing it in large quantities can now be obtained at the dental depots.

Sulphuric ether is a colorless liquid, of a sweet odor, and slightly burning, pungent taste. It is prepared by the distillation of alcohol and oil of vitriol. It is volatile, evaporating rapidly with the production of cold. On this account it is sometimes used as a local anæsthetic, with partial success. It will relieve the pain of a burn, if applied while the part is subjected to a stream of air. In earache it sometimes produces immediate relief, if dropped into the ear.

In 1844, Dr. Horace Wells, of Hartford, Conn., demonstrated the practicability of inducing an anæsthetic condition by the inhalation of nitrous oxide gas, and also the vapor of sulphuric ether; but, although he gave this information to many prominent scientific men, it nevertheless attracted but little notice until 1846, when attention was again drawn to ethereal inhalation, by Dr. Morton, a dentist of Boston, who, by calling it "Letheon," gained for it notoriety through the means of mystery. As usual with all discoveries, there are several claimants of the honor of suggesting the use of this agent to produce insensibility to pain, which is now used throughout the world. The vapor should be mixed with the air, and for that purpose it should be inhaled through a sponge, and applied over the nostrils in preference to the mouth—the fingers being kept on the pulse; and in case of its becoming feeble, the sponge should be removed until the circulation becomes more free. It produces its effects in from two to five minutes. The dose is about two fluid ounces. When it is good, it evaporates from the hand without leaving a disagreeable odor. It is very inflammable. Death has ensued from the use of ether in but very few cases; the number being infinitely small, when we consider the great extent to which it is used. It is preferred to chloroform, on account of the greater danger of using the latter agent.

Chloroform is a colorless liquid, of a very sweet and burning, pungent taste. It is made by distilling a solution of chloride of lime and alcohol.

It is heavier than ether, and unlike it in not being inflammable. On this account chloroform is a better solvent, as no danger need be apprehended from its taking fire.

It decomposes when subjected to the light, and should therefore be kept in a dark place. Like ether, it is apt to be impure. If pure, it will remain transparent at the bottom of the glass. It was discovered by Mr. Samuel Guthrie, of Sackett's Harbor, N. Y., in 1831. He supposed it to be chloric ether, the well-known oily liquid of the Dutch chemists, but it proved to be what is now called chloroform.

In 1847, Dr. Simpson, of Edinburgh, in searching for a substitute for ether, at the suggestion of Mr. Waldie, tried chloroform. Its advantages over ether are smallness of dose and more prompt action, besides being cheaper. Insensibility is produced in from one to two minutes. The dose is a fluid drachm. It is dangerous to give a full dose. There have been more deaths reported from its use than from the use of ether. Equal parts of chloroform and alcohol have been commended as the best anæsthetic agent, the latter obviating the depressing influences of the former.

Chloroform should not be administered to persons subject to epilepsy, or affected with organic disease of the heart.

Anæsthesia by electro-magnetism was discovered by Dr. Frances, of this city, a few years ago. The forceps being attached to the positive wire, and the patient's hand clasping the negative, a current of electricity is established as soon as the forceps touch the tooth. The tooth is then drawn, it is said, without pain. It excited a great deal of attention at the time, and several committees were appointed by various bodies to investigate its merits. Some of these decided in its favor, while the others ridiculed it. A brother dentist tells me that he has used it with entire success, and that he could not do without it.

The most successful local anæsthetic is the freezing mixture of ice and salt. This was first used in dentistry by Dr. Branch, of Illinois, in 1855. He employed a cylindrical receptacle, made of gutta-percha, with one end covered with a piece of bladder or membranous sac, and the other end closed, when ready for use, by means of a screw cap. Into this cylinder, pulverized ice and salt were introduced, a spiral spring inserted to press it toward the covering, and the cap screwed on. The mixture, inclosed in the bladder, was then applied to the tooth and gum until the latter assumed a white appearance, and the tooth then extracted. I have had some experience with this agent, and the only objection I have to it is the trouble of preparing the mixture, and the difficulty of applying it to the back teeth. I have been successful in extracting teeth without pain, in about six or seven cases out of ten.

On account of persons being of different temperaments,i t is impossible

to arrive at definite conclusions with regard to the success of the two last-named methods of producing anæsthesia. Some will tell us that they did not experience the least amount of pain; others will assure us the pain was very slight; and others again will affirm that the pain was very great indeed. Some will give manifestations of intense agony during the performance of the operation, and after it is done will coolly tell us that they felt no pain whatever. Of the truth of such assertions I have satisfied myself. On one occasion, before extracting a tooth for an Irish girl, which class of people I had been told would scream at the least provocation, I examined her mouth, then picked up the forceps, and deliberately held the instrument within half an inch of the tooth for a few seconds. The yell she uttered would have startled me, had I not been prepared for it.

Cases often occur in every dentist's practice, where it is expedient and proper to make use of an anæsthetic; and it would be well, therefore, for us all to take this subject into serious consideration,—to experiment under competent instructors on the various agents, so that we may arrive at a definite conclusion in regard to one or more of them; to adopt and perfect ourselves in the one that we prefer, and to use it in such instances as our judgment and conscience may permit.

Dr. Flagg said that he believed himself correct in asserting that no death of a human being had ever ensued as the result of ether inhalation, for the purpose of inducing the anæsthetic condition.

There had been cases reported of death from ether, which were either accompanied with "*no reaction*," "*not the full effect of insensibility*," "the suffering of pain during the operation," etc. etc., and the continuance of vitality, after the completion of the operation and the usual passing off of ether symptoms, for periods varying from twenty-four hours to several days.

The experiments which had resulted in death were performed on animals with sulph. ether, to the entire exclusion of atmospheric air; and in these it had been demonstrated that inhalation of ether *alone*, for a period of several minutes *after* producing a decided effect upon the medulla oblongata, was necessary for the destruction of vitality.

Dr. McQuillen, from what he had seen of and read about ether, felt pretty well assured that, if any case of death had occurred from its exhibition, it must have been due to gross carelessness on the part of the operator, and might be regarded as caused by suffocation rather than etherization. The consideration of this part of the subject brought vividly to his mind the objections which Professor Meigs urged with considerable pertinacity, several years ago, against the employment of anæsthetics in the labors of childbed. These objections, as is well known,

are embodied in a letter addressed to Professor Simpson, of Edinburgh. About that time Dr. McQ. was engaged in his medical studies at Jefferson Medical College, and recalled rather an amusing instance in which Professor Meigs, to demonstrate the dangerous nature of ether, informed the class in attendance upon his lectures that he would on a certain day etherize two animals before them, and that in a very short time life would become extinct in the animals. At the hour appointed a sheep and a lamb were placed in the amphitheatre of the lecture-room, and the ether was administered to them in the most liberal manner for more than an hour, without inducing the result which had been so confidently anticipated and announced beforehand.

Dr. Kingsbury stated that the paper that had been read treated of a subject in which he had for a long time felt a deep interest. No one would wonder at this fact when he stated that the person who first demonstrated the idea and practicability of anæsthesia in dental and surgical operations was not only a relative, but a dear friend and associate of his early youth. He loved to reflect upon the happy hours he had spent with him in the joyous and innocent gambols of school-boy days. As a boy, Horace Wells was full of vivacity, quick in his perceptions, genial in his disposition, keenly sensitive, generous to a fault, with a high sense of honor and moral obligation. He also possessed, in combination with these qualities, great ingenuity. His early associations and recollections of him were such as to justify the application of those beautifully touching lines :—

"Green be the turf above thee,
Friend of my early days;
None knew thee but to love thee,
None named thee but to praise."

He believed that it was conceded by all who were acquainted with the history of anæsthesia, that to Horace Wells, of Hartford, Connecticut, belonged the honor of demonstrating that a certain class of agents, by their inhalation, would induce an anæsthetic condition, such as to secure complete immunity from pain under surgical operations. But for his untimely death the world would have awarded to him and his posterity the meed of honor, if not the generous pecuniary reward so justly due. Justice is often tardy. But the day of reckoning will certainly come; and he was confident that justice would yet be done. Those present, who were acquainted with the history of this subject, and the unblushing, arrogant, and persistent efforts that had been made by certain parties to deceive the medical and dental professions, to establish false claims, and obtain from our Government a munificent appropriation, would require no key to unlock the import of his remarks. He would say no more at that time

in regard to the discovery of anæsthesia. Strange as it may appear there were some persons in the medical and dental professions who questioned the admissibility of anæsthetics in operations involving great suffering. Among them may be found some who occupy high positions in medical science. Dr. Simpson, in his work on Anæsthesia, has brought forward many strong arguments to silence these unreasonable objectors. Yet there is one argument of the most conclusive character that he had never seen mentioned in connection with this subject. It seems to have been entirely overlooked.

The first surgical operation of which we had any account—the record of which all must acknowledge reached back to a very early period in the history of our race—was performed before the fall in the garden of Eden upon Adam our common father. It consisted in the extraction—not of a *tooth*—but of a *rib*.

And was it not a most remarkable fact that it was performed while the subject was in an anæsthetic state? not only so, but he was previously put into that peculiar state for the express purpose of having the operation performed.

"And the Lord God caused a deep sleep to fall upon Adam, and he slept; and he took one of his ribs, and closed up the flesh instead thereof." —*Gen.* ii. 21.

What change the organization of man's physical system underwent at the time of his fall, as it respects living tissue and the functions of the nerves, he would not pretend to be able definitely to determine. But this much we do know, that "flesh" and "bone" were essential tissues in Adam's physical structure in his state of original innocence. They also entered into the framework of his helpmeet, Eve. For upon her presentation to him, he exclaimed, "This is bone of my bone, and flesh of my flesh." Where there was flesh and bone in a vital condition, there was, of necessity, a vascular and nervous system. It was fair, therefore, by parity of reasoning, to conclude that the violent separation of the living tissue of Adam's body, while in a normal condition, would be attended with pain before his fall, as well as after it. Now, as there could be no such thing as pain or suffering in man's sinless and perfect state, we see the goodness and wisdom of his Creator in placing him in an anæsthetic state, that there should be perfect immunity from pain or discomfort in the removal of the rib out of which to form a woman to be a helpmeet, part and parcel of himself. There was a striking similarity between the "*deep sleep*," induced in Adam's case, and that which is induced by the proper inhalation of nitrous oxide, ether, and chloroform. That the Great Operator, in the case cited, had the skill to have adopted some other means equally successful to the end proposed, we had no reason to

doubt. But that he chose the means he did from his resources of infinite wisdom was a most significant fact, which not only amounted to a *permission*, but was a plain *indication* that in all subsequent operations upon the human subject, involving suffering, the surgeon or dentist had the Divine warrant and sanction for the employment of the best agents for inducing a temporary suspension of nervous sensibility in order to secure immunity from the pain otherwise pertaining to such operations.

Dr. McQuillen was present on an occasion some years back, when Morton gave a description of his reputed discovery. Prior to that he had regarded Morton's claims as superior to those of Horace Wells; but the impression made upon his mind by that description was, that the speaker had very little, if anything, to do with the *discovery of the anæsthetic properties of ether*. This conviction was still further confirmed by several interviews which he had with him subsequent to that. There was such a manifest want of familiarity with the most ordinary relations of the subject, that it is a matter of surprise that any one who has once heard him could for a moment credit him with being the kind of man that would be likely to institute a series of careful and long-continued experiments, with the view of ascertaining the relative anæsthetic properties of various substances. On the other hand, it is a well-known fact that Wells possessed the peculiar temperament and mental endowments which would naturally lead to the prosecution of such investigation, and that Morton was a student of this gentleman at the time when he was thus employed. Dr. Wells' claim to the credit of discovering the *anæsthetic* properties of ether might be questioned by some persons, but no one, certainly, can deny that he was the first to practically demonstrate that anæsthesia could be induced, by the inhalation of certain substances, to such an extent that painful surgical operations could be performed without the knowledge of the patient.

Dr. Flagg remarked that the present conduct of discussion seemed not to indicate an arrival at that experience and material which might be of very wide-spread benefit to the members present, and to those of the profession who read the proceedings of the Society. He thought that the discussions upon this subject, which are reported from various organizations, though good so far as seemed feasible, were yet devoid of that systematic and practical instruction, which might possibly be obtained from a somewhat different treatment of it. He would, therefore, propose that a *seriatim* method of investigation, demonstration, and discussion be pursued; that the substances or compounds from which the various anæsthetic agents were obtained, be exhibited and described, and that their manufacture be demonstrated, so that all should have clear ideas in this direction; that the materials having been obtained, practical illustra-

tions of their employment should be given, their effects noted, and their probable modes of action discussed; that measures for the removal of untoward signs or symptoms, should such supervene, be suggested, and the *rationale* of their employment be arrived at if possible.

Therefore, as the protoxide of nitrogen was the gas, by means of which Horace Wells, a dentist of Hartford, Conn., first demonstrated the feasibility of the induction, by inhalation, of anæsthesia, during the performance of a surgical operation, he suggested that its description, and a demonstration of its manufacture, be requested at the hands of Prof. Morton.

Professor Morton said that nitrous oxide, or the protoxide of nitrogen, may be obtained in greater or less purity by several processes:—

1st. By decomposing nitric oxide by the long-continued action of iron filings, or other absorbent of oxygen.

2d. By the action of dilute nitric acid upon zinc or tin.

3d. When nitrosulphate of ammonia is thrown into an acid.

4th. By dissolving protochloride of tin in hydrochloric acid; heating the solution in a retort over the water-bath, and dropping in crystals of nitre through a tube dipping into the liquid.

5th. By heating the nitrate of ammonia in a flask or retort until a gentle ebullition takes place in the fused salt, and keeping up this action until the material is nearly exhausted.

The gas is obtained in a pure state only by the last two methods; the last of all, on account of economy, ease of manipulation, etc., being the one practically employed. The decomposition here is as follows: $NH_4O,NO_5=4HO,+2NO$. Water and nitrous oxide being the only products, the flask would be left empty, if the operation were continued long enough, which a prudent regard for the safety of our glass flask alone forbids.

Where the salt used is somewhat dry, a little difficulty often arises from frothing at the beginning of the operation; the addition of a few drops of water, or very careful regulation of the heat at the outset, will avoid the inconvenience, which is not permanent, as the generation of water during the decomposition soon so *thins* the fused salt that frothing cannot be induced. The heat during the process should be well regulated, as too high a temperature may cause the development of nitric oxide, which would be very injurious, if inhaled, or even of pure nitrogen, which would be, of course, a diluent, diminishing the efficiency of the gas. The nitric oxide might be removed by passing the gas as generated through a washing bottle, containing a solution of protosulphate of iron, which would absorb the impurity, but not the required product. The absorption of this gas by water ($\frac{3}{4}$ vols. being so taken up) makes the ordinary pneu-

matic cistern an objectionable means of collecting it; yet it should come in contact with some water to remove such impurities as a trace of nitric acid, which may sometimes occur, and have some opportunity of depositing the water which accompanies it as steam in its exit from the flask or retort. These ends would be best subserved, on the large scale, by the use of a copper gas-holder as a reservoir, and an India-rubber bag of two or three gallons capacity as an inhaler.

In illustration of these remarks, Prof. Morton heated some nitrate of ammonia in a glass retort, and obtained a large quantity of the nitrous oxide, which was tested by the members present.

Dr. McQuillen referred to Dr. Arnott's improved mode of using refrigeration as a local anæsthetic, and suggested that possibly it might be made available in the extraction of teeth.

Dr. Tees had tried Dr. Arnott's method, but failed; this, however, was probably owing to the want of thorough application, having used but a single iron.

Upon motion, the subject was continued for discussion at the next meeting.

Adjourned.

A MONTHLY meeting of the Society was held on Tuesday evening, November 3d.

Upon motion, Dr. Lusson was called to the chair.

The discussion of the subject of "Anæsthesia," continued from the preceding meeting, was declared in order.

Dr. Ellis said that the duties of reporting so engrossed his attention during discussion, as to almost entirely preclude the possibility of concentrating thought sufficiently to enable him to express his views upon matters, whose importance and interest often offered the strongest inducements for an active participation in their investigation. He could not, however, resist the inclination to join in the consideration of a subject which had from the first days of his dental pupilage enlisted his special attention, and from the apparently limited knowledge of its various principles, stimulated the desire and design of making it a special study.

The remarks of the previous evening had taken a somewhat different direction, and were of a less practical nature than he had anticipated, yet their importance was great in assisting to fix the credit of the first employment of ether as an anæsthetic, in surgical operations, upon whom it is due. With a full knowledge of the heated nature of the controversy, and the ardent claims urged by the various contestants, this body has seen fit to accord the honor to Dr. Horace Wells, of Hartford, Conn., to

whom, from all we can learn, it undoubtedly belongs. He regarded both ether and chloroform as blessings to humanity, and, like many of the good things with which we are favored, open to either *use* or *abuse;* the former, however, he believed, on account of its comparative safety, to possess the preference, at least among the majority of American surgeons and dentists. With the conviction of its advantages in this respect, national pride would, as a *secondary consideration*, naturally and properly assist in strengthening our prejudices; but no such feelings should debar us from a thorough investigation of its merits, or influence us in rendering any other than an impartial decision. His enlistment under the preceptorship of Dr. J. F. B. Flagg, who was a pioneer, enthusiast, and recognized adept in the administration of anæsthetics, might have done much to awaken the lively interest he felt in the matter; and the unusually extensive ether practice which Dr. F. enjoyed, offered valuable advantages for obtaining a practical knowledge and securing that confidence and skill which can only result from a familiar acquaintance with the subject. He has been in the habit of exhibiting ether to the almost entire exclusion of chloroform, except as an adjunct, although he unhesitatingly employs the latter where circumstances indicate—for, fear would not prevent its use—believing, as he does, that knowledge and skill divest it of a very large per cent. of its imputed danger. He considered both capable of destroying life, and although both are dangerous, they are not equally so, owing to the greater rapidity with which chloroform induces its effects upon the cerebro-spinal axis. He was aware that many regarded ether as perfectly harmless, yet experience has confirmed him in a contrary opinion, inducing belief in a lurking danger, capable of development through ignorance and injudicious management, for, that death has never followed its inhalation, is by no means proof positive that it never will.

It is indispensable that a competent etherizer should possess an accurate anatomical knowledge of the parts which he is endeavoring to impress; a full information relative to their physiological properties; the confidence which a consciousness of ability inspires; and, in addition, an indescribable gift, like the inherent talent for music, painting, etc., and which might be termed anæsthetic *intuitiveness*. That a man is capable of recognizing signs as they present is not sufficient; he should be not only cognizant of their appearance, but capable, through the agency of his anatomy and physiology, of interpreting their cause and exact point of origin, for should dangerous results be threatened, his ignorance of their nature would serve as an effectual manacle to prevent the exercise of systematic or well-directed efforts for averting disastrous consequences.

In the course of a conversation between two members of the profession upon chloroform, one, lacking confidence in its safety, asked, "But how do you guard against danger?" To which the other replied, "By closely watching for its first manifestation." Whence came the reply, "You are watching closely for what you fear to see, and should it occur, any exertions for preventing a fatal result would most likely prove abortive." This is true, and illustrates the worthlessness and unreliability of abstract signs without the ability to refer them to their proper cause, and in a measure anticipate their appearance.

He said that, as the great number of cases in dental practice calling for the use of ether or chloroform offered extensive advantages for the acquirement of experience and dexterity far more numerous than those afforded in a medical practice of corresponding size, it was reasonable to infer that the intelligent dentist should possess anæsthetic skill at least equal to that of the physician; consequently he would oppose the argument offered in favor of the presence of a family physician during the exhibition of an anæsthetic, upon two grounds, viz.: 1. From the inconvenience resulting from the frequent seeking of the one, and the frequent attendance demanded of the other. 2. From the fact that it is censurable for a man to undertake an operation which he feels incompetent to satisfactorily and understandingly perform, and the entire responsibility of which he is unwilling to assume. Far better to submit it entirely to one more able, than to hold him partially or wholly responsible for the bungling execution of an operation pre-eminently demanding skill.

His plan of exhibiting ether is from a sponge, held in the hollow formed by the palms of the hands, directing the patient to breathe through the mouth, as more prompt and agreeable effects are induced than when inhaled through the nostrils. He doubted the direct sedative effects of ether from local application, and regarded the diminution of pain resulting from its application to a burned surface, as due to the cooling or antiphlogistic effect exerted by its rapid evaporation.

Dr. Wardle did not regard the use of an anæsthetic agent in dental operations as of absolute importance; could not favor its use in what he considered a light operation, such as the removal of a tooth or a few teeth. Would not object to, but favors its use in formidable surgical cases, such as the removal of a limb or cases of like severity. In his practice would rather never use it; he disliked the excitement it was too apt to induce in the patient or accompanying friends; objected to the violence which the anæsthetic state seems to invite, the evidence of which was manifest in the mouths of some; he also disliked its use on account of the condition which the patient was too apt to assume during the unconscious state, the blood besmeared to a greater or less extent upon the sub-

ject's face around the mouth, which was not altogether avoidable where a number of teeth had to be extracted; he felt as much interest in extracting teeth where it was needed to relieve suffering, as he did in any other necessary operation.

Dr. Ellis took exception to the statement that the employment of ether should be limited to surgical cases of a formidable nature, and entirely ignored in the performance of an operation so trivial as the extraction of teeth; for, although the extent of the operation would *in a measure* influence our judgment, the *strength* and *endurance* of the patient are the main points for consideration.

It can be readily understood that the shock and subsequent depression occasioned by a major operation upon a patient of great physical strength would be less than that resulting from a minor operation upon one in an exceedingly debilitated and nervous condition; consequently the operation of extraction will very frequently clearly *dictate* the use of an anæsthetic as the means of obviating this shock. He thought that anæsthetics should be entirely avoided by those who would rather not use them. He believed that the persistent excitement referred to was often the sympathetic offspring of a similar condition in the operator, the almost infallible antidote being calmness and decision upon the part of the latter. He did not regard the fact that an anæsthetic condition offered inducements for an unnecessarily violent operation, as any argument against the use of such agents, but as an indication of a lack of that coolness which should characterize a good operator.

It had been urged that the use of ether leads to an unnecessary consumption of time; his experience, however, had taught him the contrary, and frequently suggested its use, as a matter of economy, in that direction. He is in the habit of using ether whenever a patient requests it, and advises it in the majority of cases presenting for the removal of teeth; and although some gentleman had expressed an enjoyment of the operation, the avidity with which ether is embraced as a means of avoiding pain, has convinced him that the fondness of patients for its performance might be estimated at considerably less.

Dr. Wardle held it to be very important to have his patient in a proper frame of mind to have teeth extracted even in a normal state; he always wants the entire and implicit confidence of his patient when he is to operate, and without it he did not care to operate; could gain that kind of confidence in 99 out of the 100 of intelligent minds; makes it a point never to deceive or make unreliable promises to patients of things which may or may not occur; in that way he failed in obtaining the confidence only of those who seemed to be incapable of understanding what was said to them, or unable to believe a statement; and for such he had no desire to operate, as it was unpleasant to both.

He sometimes gives ether, but did not like to administer it without a previous understanding with his patient; he desired the stomach free from food; had witnessed a case in the hands of a gentleman of some renown, where the patient was enjoined to abstain from taking any food from the previous evening until the next noon, when the teeth were to be extracted, but who from a feeling of weakness took a very small portion of food at ten in the morning, from which disobedience emesis was brought on, and resulted in spoiling a valuable dress; at the next exhibition at a subsequent day, she felt a sense of strangulation, when, in a violent struggle, she removed the agent from her mouth, but being overpowered by opposing force she submitted, and the operation was performed; to him such exhibitions were not pleasant, particularly for the extraction of teeth.

Dr. Flagg would say that it was his conviction that *intuition* was, after all, the only true basis for eminent success in the use of either anæsthetic agent which had as yet been employed; but he thought that this "intuition," and a thorough anatomical and physiological knowledge of the parts to be affected by the administration of these agents, were wonderfully prone to go together hand in hand! He would take exception to this question of uncleanliness, in the direction of nausea, for he had been, for several years, in the habit of almost exclusively confining his anæsthetic practice to the *afternoons;* he was within bounds when he named 2000 as the number of administrations during the past five years, and although he never gave any directions as to the quality or quantity of the dinner to be taken by patients, and had known them frequently to come immediately after dining, giving him the information that they had taken an extra meal in view of the loss of their remaining dental organs; yet he could recall but two cases where nausea was of sufficient intensity to produce emesis; when signs presented which indicated that tendency, it was easily controlled by the exhibition of a few drops of chloroform, combined with ten or fifteen drops of comp. spts. of lavender.

Mention had been made of untoward results, such as suffering, nausea, etc., at the hands of a *good exhibitor* of anæsthetic agents, whose credentials for skill consisted of a prominent position and frequent occasion for their use in the practice of general surgery. He would regard, on the contrary, that the untoward results would rather prove that while the gentleman possessed sufficient knowledge to successfully supervise the induction of the anæsthetic condition for the purpose of operations in general surgery, (which, by-the-way, required but a very low order of power in this direction,) it was as clearly demonstrated that he was utterly incompetent for conducting patients into the state of anæsthesia, with the view to perform dental operations. This he regarded as de-

cidedly a *specialty* of anæsthesia, and one which his varied experience indicated as that requiring the very highest power for the accomplishment of such markedly successful results in difficult cases as would cause them to be satisfactory alike to patient and operator. Such administrations as had been referred to would not do for dental practice, and it was just such administrations as these that dentists would be most likely to secure at the hands of the "family physician," when they chose to ignominiously shirk their proper responsibility, or take part in an operation which had to be conducted by some one else, *because* this other "knew how to do it!" No *true* dentist would be guilty of joining in any proceeding which he thought could possibly be detrimental to his patient, much less should he have a partner *for the purpose* of clearing his own skirts in case untoward sequences should result, for this is demeaning his specialty. Thought that while it was often not only admissible, but decidedly advantageous to have in obstetrical and surgical cases both an administrator and an operator, it was of no less advantage in dental operations that they should be comprised in one individual.

He then read several cases of reported death from chloroform, and pointed out in detail the evident *incapacity* which the report of the cases proved to exist on the part of those who attempted the exhibition of the agents, and showed that *duplicity* and *ignorance* had probably much more to do with the fatal result, and the induction of all the "*horrid, melancholy, fearful, ghastly, livid*" concomitants, than the blessed agent, which, in proper hands, might have been instrumental for the alleviation of all suffering. "Everything was done" for the revival of these patients "without success!" Was it not reasonable to conclude that the very "doing of everything" at such hands, was the true cause of the *final* extinction of the vital spark?

Dr. McQuillen said that while there are no well-authenticated cases on record of death from etherization, the statistics of Dr. Kid prove most conclusively that death has frequently ensued from chloroformization. In a communication to the *London Medical Times and Gazette*, that gentleman says "thirty-six deaths from chloroform are noted this year, all due to a want of A B C knowledge of the subject." The recent death of young Skey, a promising physician himself, and the son of the celebrated surgeon of the same name, should dispel any doubts which may be entertained by some practitioners as to whether chloroform can be a direct and unquestioned cause of death. In this case, young Skey, who was subject to severe attacks of neuralgia, and in the habit of employing chloroform as means of relief from the intensely agonizing pain under which he suffered, excused himself to the family in this instance while laboring under a severe paroxysm, and retired to his room, where

he was found some time afterward in a lifeless state, kneeling in front of a chair with his face buried in a pocket handkerchief held in his hands, and with unmistakable evidence that chloroform had been freely used by him.

The employment of an agent so powerful in its effects demands, on the part of those who engage in its administration, a *perfect* acquaintance with the anatomy and physiology of the brain and spinal cord; and the manifestations presented to the eye and ear of the operator of the impressions made upon the cerebrum, cerebellum, pons varolii, and medulla oblongata, through the medium of the *cerebral nerves.* No study can possibly be more *interesting*, or more *practical* in its application, than to note the faithful record of the effects of chloroform on the brain made by the olfactory, optic, auditory, portia dura, pneumogastric, hypo-glossal and other nerves constituting the twelve pair of cranial nerves; and any one who is unable to read that record in a clear and intelligent manner, is unprepared to deal with an agent so fruitful of good or ill to his patients.

There is no comparison between the effects of ether and chloroform, when each are given *ad libitum.* The volatile character of the first promptly relieves the system of its narcotic influence, so that symptoms of *apnœa* disappear almost immediately with the removal of the sponge; owing to the greater density of chloroform, on the other hand, the vapor in the lungs in alarming cases can continue to exert a deleterious influence upon the *nerve centres* for some time after the appliance employed for the administration of the agent has been put aside by the operator.

Owing to the marked evidence communicated to the atmosphere of the operating room, and the tendency to headache which accompanies the exhibition of ether, he would much prefer chloroform, if he regarded the latter as safe as the former. Unpleasant as ether is to him, recognizing the claims of patients, he is in the habit of using it when requested to do so.

There is a great difference between the administration of ether on the part of a surgeon, an obstetrician, or a dentist. The first may have occasion to perform a surgical operation upon a patient in a private house, in the clinic of a college, or the wards of a hospital. The anæthethic is usually administered by an assistant; the operation performed after the induction of anæsthesia will possibly demand from ten minutes to one hour of the surgeon's time, when he can pass at once into the open air, freeing himself not only from the unpleasant effects of the agent, but every evidence of its use, so that he can call upon any number of patients without the slightest trace being manifest to them. The same is also true of the obstetrician. With the dentist it is different;

having administered ether to a patient, he and the patients who visit his office during the remainder of the day must inhale that portion of the article which has become mixed with the atmosphere of the operating room. An effort may be made to ventilate the room by throwing open the windows and doors, but unmistakable traces will be left unpleasant to many who visit the office, and if the article is used frequently during the course of each successive day by an operator, it cannot but exert a marked influence upon his nervous system. Considerations such as these would induce him to prefer chloroform, if he could regard it as safe an agent for patients as ether.

Dr. Flagg said that for his own use, if he had any preference as to anæsthetic agents, it was for chloroform; though he thought that for general use, (especially by those completely ignorant in relation to those subjects upon which one should be informed, if he proposes administering to his fellow-beings such agents as were under discussion,) sulph. ether was decidedly the better. His reasons for this were twofold, viz., that the effects were induced much more slowly by the ether than by chloroform; and that one effect of ether was not unfrequently to make patients perfectly unmanageable *by such operators* long before any portion of the medulla had ceased the exercise of its functional action; this might be regarded by the majority of practitioners as rather *negative* testimony as to *superiority* in an agent, but he felt sadly convinced of its propriety. As regards the safety of chloroform, he would say that he had yet to read the first account of death from that agent which had convinced him that the fatal result was attributable to the chloroform; but he would admit having read a great deal which pointed in a very opposite direction for the solution of the mystery attending the sad catastrophe. He did not believe it possible for any persons so to administer chloroform *to themselves* while in a sitting posture, as to give rise to the suspicion in the mind of any one capable of exercising judgment in such a case, that this agent was the *cause of death.* He was willing to concede that while in the state of unconsciousness, such a position might be fallen into as would mechanically prevent respiration, and thus produce asphyxia. He referred to the case of the druggist's apprentice, (*London Med. Gazette*, Feb. 1848,) where the patient had been left for *twenty minutes, after snoring respiration had attracted attention*, leaning forward on a counter, with his face buried in the folds of his apron! This seemed to him very like announcing the dangerous character of *mud*, because a man, while intoxicated, had fallen with his face in a quantity of it and had been found dead.

Dr. McQuillen said he could not understand how it was possible to entertain any doubts with regard to the fact that chloroform can cause

death. No one would think of denying that morphia or other powerful narcotics can suspend the functions of the brain and spinal cord; and owing to the respiratory phenomenon depending for its influence on both of these, that under such circumstances it is arrested. The same is true of chloroform, when pushed to such an extent as not merely to induce loss of sensibility and consciousness by the impressions made upon the cerebrum, but also to suspend the function of the *medulla oblongata.* Arising as the *pneumogastric* nerve does from this latter body, and sending branches to the lungs, heart, stomach, and other directions, and exercising a powerful influence over the action of the various organs named, and particularly the respiratory, when chloroform makes such a marked impression as to suspend the function of the *medulla*, respiration will of necessity cease. Experiment upon experiment has demonstrated beyond all cavil, that the *medulla oblongata* is the *centre* from which the respiratory nerves arise; other parts of the spinal axis may be destroyed without necessarily destroying life; but let this *vital centre* be removed, or its function entirely suspended, and life becomes extinct. This has been recognized as a fact from the time of Galen; the modern investigations of Bell, Magendi, Flourens, Longet, and Brown-Séquard have, however, thrown additional light upon the subject.

Dr. Flagg called attention to the ordinary inverse ratio in the action of cerebral stimulants, offering the suggestion that those which induced the state of unconsciousness the most slowly, were by no means the most persistent; while those which acted quickly, were by no means the most evanescent. Thus it was that while sulph. ether required a longer time than chloroform for pronouncing its obtunding effects, the duration of insensibility caused by the latter was often much greater than that of the former; thus, he had one case in which *three inhalations* of chloroform had occasioned insensibility of nearly a minute's duration; whereas, on the other hand, several minutes' advantageous administration of sulph. ether would oftentimes produce but momentary loss of sensation. The difference, as regarded loss of consciousness, was even more marked than that of loss of sensation. He wished to remind the members of the utility accruing from the use of electro-magnetism in cases where, through ignorance or otherwise, the exhibition of an anæsthetic had been continued so far as to produce inability on the part of the pneumogastric to respond to its special stimulus. In such case the positive pole was to be applied to the cervix, opposite the origin of the phrenic nerve, and the negative pole over the lower portion of the sternum.

Dr. McQuillen having been asked "how is it possible for the patient to continue the inhalation of chloroform, after the tongue has fallen back into the pharynx, so as to produce a decided and fatal impression upon

the medulla oblongata?" replied that the fact of the tongue being paralyzed to such an extent as to fall into the pharynx, is to him unmistakable evidence that the function of the *medulla* has been seriously affected, for the *hypo-glossal* or *motor nerve* of the tongue arises from that body, and derives its motor impulse from it. Respiration being arrested under such circumstances, the inhalation of course would cease, but the vapor already in the lungs would continue to exert a baneful influence upon the nerve centres, and if prompt employment of remedial agencies is not made use of, life will soon become extinct. As Bichat said, life rests upon a tripod formed by *innervation*, *respiration*, and *circulation*. The last of these to be arrested as a general thing is the *circulation*, and this is owing to the rhythmic motion of the heart continuing independent of the nervous system; this action, which is due to a remarkable property of *irritability* or *contractility* possessed by the organ, is an endowment peculiar to it, and that it is independent of the nervous system, can be proved by the continuance of the action, after severing the connection with the brain and spinal cord. This is more marked and of longer continuance in the cold than in warm-blooded animals. The remembrance of this fact is of vast practical importance in cases like that under consideration. The first indication, therefore, in such cases, is to raise the tongue from the position in which it has fallen, so as to keep the pharynx and larynx open to admit of the passage of air to and from the lungs, during an effort which should then be made and diligently continued, to keep up by artificial means the mechanical phenomena of respiration, trusting that as the influence of the chloroform passes off, the nervous centres may resume their accustomed functions, and respiration be completely re-established. The simplest, best, and most philosophical plan which has been proposed for maintaining artificial respiration, is the one first suggested by Dr. Sylvister, viz., the patient is placed upon the back, and the hands are then seized by an operator, and the arms alternately carried over the head and compressed against the thorax, at the rate of fourteen to sixteen times a minute. During this manipulation, the thoracic cavity is enlarged when the hands are extended over the head, and an opportunity is afforded for the air to rush into the lungs; then, on bringing the arms down to the sides of the thorax, the lungs are compressed and the air is driven out.

Dr. Wardle said that he was very much interested in the facts which were brought out during the discussion; he thought that the gentleman lost sight of one fact when he contended "that the death of patients who died during the anæsthetic condition, could by no means be attributed to the agent, it was the closing of the glottis."

Now to illustrate this, he said, you could not hold the horse and wagon responsible for a theft; it was the *man*, the *active agent*, who was chargeable with the deed.

Or, if he might use another simile, and in another form of speech, he would say that it was not the rope around a hanged man's neck which killed him, (when his neck was not broken;) it was the closing of the glottis! a very good thought for the remaining friends; *i.e.* he did not die from having a rope around his neck, he only died from the closing of the glottis!

Dr. Flagg accepted the interpretation as correct, and admitted that if the rope was the means of breaking the neck, then it was the cause of death; but if by compression, it merely produced temporary strangulation, and its removal would prevent death, then, if death occurred, it was clearly not the fault of the rope, but due to the inefficiency of the attendant in not removing it!

On motion, adjourned.

A MONTHLY meeting of the Odontographic Society was held on Tuesday evening, December 1, 1863, in the Philadelphia Dental College.

Vice-President, Dr. Kingsbury, in the Chair.

Dr. McQuillen, the Corresponding Secretary, presented a communication, which he had received a few days before, from Dr. J. F. Vegas, a corresponding member of the Society, residing in Bahia, Brazil, comprising a translation of an editorial from the *Diario da Bahia*, favoring the establishment of a department devoted to dentistry in the University of Bahia, along with the application made to the trustees of the institution for the establishment of the department. It is as follows:—

"Friendly as we are to those ideas which may by their good results bring great advantage to scientific progress, we cannot fail to applaud with enthusiasm all and every improvement for the benefit of the people.

"By reason of the reform of the medical schools, the government has comprehended that it had become needful to raise up men who might dedicate themselves to the specialties of the different branches of which the medical course is composed, and the views of the government were magnificent, for it sought not merely to prepare practitioners of acknowledged merit, but to instill into the youth the progresses along which these different branches of the science are marching.

"Among us, however, encyclopedism is exacted of the medical man; the public considers that the doctor should be operator, accoucheur, and dentist, because the diploma of doctor of medicine confers on him the profound knowledge of all the scientific branches, and woe to him who limits himself to the exercise of this or that specialty, and for this reason

refuses to undertake an operation of another class when called on. France and England think differently. Ricord, Nélaton, Denonvillier, Desmares, Velpeau, and Dubois are specialists; and certainly it cannot be disputed that these great intellects are each exercising, however, a specialty.

"These observations were suggested to us by reading the considerations, published below, offered to the Ex. Sr. Counselor, Director of the Faculty of Medicine of this city, by Dr. J. F. Vegas, showing the necessity for the creation of a special chair of dental surgery in that school.

"This improvement, with the conditions which Dr. Vegas presents, is of incontestable advantage to the alumni of our faculty.

"The United States, Prussia, Germany, and, we believe, even Portugal have accepted it.

"Diseases of the mouth ought to merit a serious study on the part of the observer. Among us, with some honorable exceptions, dental surgery is given up to empirics, who know this art only by practice, and that badly.

"Who is ignorant of the fatal consequences that have followed the extraction of a tooth by a mere tyro? The medical journals enumerate facts of individuals who have suffered from fistula, caries, and necrosis of the maxillæ in consequence of a bad extraction, and even poisonings by the application of copper plates. How many evils have not been produced by those *famous* barbers who hang at the doors of their houses the symbolical razor, towel, and basin!

"The government has recognized so far the utility of the study of surgical dentistry, that we are told it has ordered the dismissal from some of the military hospitals of the employee charged with the extraction of teeth, obliging the surgeons of these establishments to practice these operations.

"In our schools this study is entirely ignored, and, reflecting on the advantages that our youth may gather from it, we thank Dr. Vegas for the happy idea, desiring that the Ex. Sr. Counselor, Director of the Faculty of Medicine, may set before the government the necessity of creating this chair, which may produce noble results.

"*To the Illust. and Ex. Sirs, Counselor Director of the Faculty of Medicine of this City, and the other Members of the same:—*

"The undersigned comes respectfully to present the following considerations to the attention of the faculty for their deliberation, hoping that his observations in favor of the public good—which is much interested in this matter—may be perfectly appreciated, and receive their cordial approbation.

"A glance at the lamentable state of the dental profession in Brazil, where the resources for a complete instruction are not within reach of those who might desire to study it as a profession, places the greater part of the practice of dentistry in the hands of impostors, who, without education, whether primary or professional, leave some unlucrative craft to embrace the lucrative, and, as yet, but little explored profession of the dentist, and who, in place of elevating the profession to the position it occupies in the United States and other progressive countries, degrade and abase it, to the detriment of humanity.

"These considerations have led me to think that a well-directed dental branch in the Medical School of Bahia would combat this evil in great measure. Bahia occupies the central and most advantageous place in Brazil, and with the establishment of this department, well-educated and respectable young men of this and other provinces would come here to study the dental profession, and in a few years dental practice would be in the hands of men of intelligence, and the public in general would derive an incalculable benefit from this.

"In order that this prove successful, it is needful that it be established and directed on the plan of the colleges of dental surgery in the United States, where the courses are chiefly practical, thus fitting the students to assume the responsibility of public practice immediately on concluding their apprenticeship.

"To this end a hall should be set apart for a laboratory, with all the needful elements, where the students may instruct themselves in all the various manipulations of the mechanical part of the profession, from the manufacture of porcelain teeth and the preparation of all the materials used in the mechanico-dental art up to the completion and collocation of a set of teeth in the mouth.

"A hall for clinics is also needful, with a sufficient number of chairs for the students to practice therein all the operations required in the mouth, each student furnishing his own instruments, excepting those of extraction, which should be supplied by the college.

"The poor should be publicly invited, through the journals, to come gratuitously to the clinic for any dental operation, and for the collocation of artificial teeth, the cost of the materials being defrayed either by the college or by the students, as the faculty may determine.

"If the faculty shall judge this, my idea, suitable for such instruction, it may accept of me to explain to the students the different parts of dental instruction, or may invite some one more fitted to place at the head of so useful an instruction, and, on the fitting occasion, I will offer to the faculty a regulation I have at hand, such as is practiced in other countries.

"In submitting these, my ideas, I have no other end in view than to ennoble and elevate the dental profession, and at the same time to benefit the public.

(Signed) Dr. J. F. Vegas.

"Bahia, March 21, 1863."

Nitrous oxide being the subject for consideration, was then introduced by Dr. Tees, who exhibited the apparatus he employs, and, describing it, said: This apparatus consists of a retort, a purifier, and a five and a ten-gallon bag. The purifier is a modification of Wolf's bottle, made of tin or galvanized iron, of one-half gallon capacity. The bags are somewhat different from the ordinary India-rubber ones, having muslin or silk linings for the gas to come in contact, thus rendering it pure, and preventing that disagreeable taste so repugnant to many individuals.

As it can be managed by a child after a little instruction, and can be furnished complete for the sum of fifteen dollars, its simplicity and comparative cheapness will recommend it for general use.

Heretofore nitrous oxide gas has been manufactured for practical purposes in a wine barrel, or copper or tin gasometer, holding about forty gallons. Since water absorbs a large amount of the gas, this is not an economical way of making it, and since it is necessary first to fill the barrel with forty gallons of water, it is not at all convenient, unless running water and a sink or bath-tub is at hand.

The gas can be kept in the apparatus for a week or more, but since it can be generated so quickly, I can see no especial advantage in this. By having a quart or half-gallon retort, and keeping it always half filled with nitrate of ammonia, so as to present a broad surface for the gas to escape, and keeping the apparatus on a table in the office, (a small-sized table being sufficient,) it can be generated as fast as it is used. The ten-gallon bag can be filled in the morning, and kept filled during the day, in that way being always prepared. If more than that is required for an operation, the small bag can be filled from the large one, and the latter attached to the purifier to be filled up, which can be done by the time the bleeding from the first operation stops. By this means as much gas may be obtained as will be needed, with but little if any extra trouble. As far as my experience goes, both personal and with my patients, it is as good when first manufactured as it is when allowed to stand for any length of time. The gas can be kept for twenty-four hours in one of these bags without being affected by the possible action of *endosmose* and *exosmose*. I think, however, it is more economical to generate it as it is needed.

Prof. Morton said the "rationale" of this arrangement of apparatus is as follows: The gas escaping from the flask is caused to bubble through the water in the second part of the apparatus, in order, first, that it may

be cooled and so deposit the steam by which it is accompanied; second, that any free nitric acid which may by chance be present in the salt (nitrate of ammonia) may be absorbed; and third, that any nitric oxide which may by chance be developed by too high a heat, may likewise be removed (by absorption in the water) from the gas.

The vessel in which these actions are carried on is made small, and the amount of water in it is limited, because a small portion is sufficient thoroughly to effect all these objects; while a large quantity would occasion serious loss by absorbing the nitrous oxide produced, of which water will take up three-fourths of its volume. Lastly, the gas is collected and stored in an India-rubber bag in preference to the ordinary pneumatic cistern or gas-holder, to avoid this same wasteful result of contact with large quantities of water, which can, it is true, be dispensed with in certain forms of the last-mentioned apparatus; but only by a large outlay in the first cost of construction.

The meeting was mainly devoted to the demonstrations of persons under the influence of nitrous oxide. Several present at the meeting inhaled the gas, with quite satisfactory results, so far as the control of an operator over his patients was concerned.

Adjourned.

THE regular monthly meeting was held on Tuesday evening, January 5th, 1864, at 8 o'clock, in the rooms of the Philadelphia Dental College.

Dr. Kingsbury in the Chair.

The minutes of the previous meeting read and accepted.

The Executive Committee presented the following report, and, upon separate ballot, each gentleman therein mentioned was unanimously elected.

Active Member—Dr. A. B. Robbins, Meadville, Pa. *Corresponding Members*—Dr. Amos Westcott, Syracuse, N. Y.; Dr. Wm. Cahoon, Detroit, Mich.; Prof. James Taylor, Cincinnati, Ohio. *Honorary Members*—Dr. Geo. J. Ziegler, Philadelphia, Pa.; Dr. J. F. B. Flagg, Burlington, N. J.; Dr. R. Shelton Mackenzie, Philadelphia, Pa.

A letter was read from Dr. Ab. Robertson, of Wheeling, Western Virginia, donating to the library of the Society a copy of his valuable work on *Extracting Teeth.*

Prof. Morton also presented 34 numbers of *Silliman's Journal of American Science.*

On motion, a vote of thanks was tendered to these gentlemen.

Dr. McQuillen said that he regretted to announce the death of their

fellow-member, Dr. H. Leibert, of Norristown, who took a warm interest in the establishment and prosperity of this Society. Although not much known to the profession, he was a gentleman possessed of excellent abilities, and when a student attracted the attention of the speaker by his uniformly studious habit and gentlemanly deportment. He had devoted several years to the study of chemistry in particular, and it was while engaged in making some experiments in the manufacture of gunpowder, endeavoring to improve, no doubt, upon a compound for which he had obtained a patent, that he met with his death by an explosion. An event such as this called for some action on the part of the Society expressive of the manner in which the members viewed the loss sustained.

Drs. McQuillen, Morton, and Ellis were appointed a committee to draft resolutions which should embody the feelings of the Society relative to the death of their esteemed member, Dr. Leibert.

The following paper was then read, and illustrated by a number of interesting experiments:—

"PHYSIOLOGICAL RELATIONS OF PHOSPHORUS."

BY HENRY MORTON, A.M.,
PROF. OF CHEMISTRY IN THE PHILADELPHIA DENTAL COLLEGE.

If we were required to say, from a general inspection of their properties, which of the elements was least likely to occur in a living, organized body, I think we should not fail to accord this distinction to phosphorus. More poisonous than arsenic, more readily ignited than any other element, bringing corruption into the flesh and decay into the bones of those who often handle it, we might well conclude that the very last substance which could be admitted into the delicate fabric of a living body, was this incendiary, ever ready to fire life's habitation—this poisoner, ever prompt to slay the spirit dwelling within. Yet this natural conclusion would be utterly false. Phosphorus not only *is found* in organized bodies, but it *abounds* in them. It occurs in almost every part, and especially in the most delicate organs—resides chiefly in the higher orders of animals, and there presents itself in greatest profusion in the brain, and is so important to the well-being of this part that its deficiency implies idiocy, its abundance intellect.

Should we then conclude that nature here violates her general law of using for each work the most fit material? Or rather look further into the properties of phosphorus and the requirements of a living creature, and, by enlarging our knowledge of both, teach ourselves perhaps at last that here, as elsewhere, nature's means have to her ends the closest possible relation of sufficiency and fitness?

This last course we shall pursue, and, in following it out, we shall first inquire what distinguishes an organized being; then, what sort of powers are required in the particles of which such a one is composed; then, how far this substance—phosphorus—fulfills these requirements; and lastly, if any other resembles it, and how far.

We all know that an organized being is distinguished by the possession of a force, which is not heat, nor light, nor electricity, nor gravitation, nor any other of the physical forces, however closely it may be related to some of them—and we call this force "life." But here our knowledge almost ends. This life-spirit is the most timid of all the forces. We can capture and imprison the sunbeam in the meshes of the collodion film*—we can shut up the lightning in the Leyden phial†—but when, with the scalpel of the anatomist, we seek to break into the palace of "life" and seize upon its inmate, she flies before us, from tapestried chamber to crimson-lined gallery, and as we follow, still retreats, from room to room, until at last, when we have driven her to her last resort, and hope to make a sure discovery and capture, we find but a soundless, uninhabited, and empty vault—the object of our search has perished or is fled. The life-spirit, like the echo, answers harmoniously, though obscurely, to our *distant* questions, but is mute at our approach. Like the sensitive plant, she shuns the human hand, or like the nautilus, sinks when we draw near, down from the breezy sunlight of life into the dark ocean of death, far beyond our sounding. We must content ourselves, therefore, with only a general knowledge of this life-force, obtained by an observation of the works which she accomplishes.

Taking the simplest case of vital action in the growth of a cell, we find two processes in constant and simultaneous operation: one of assimilation and conversion, by which foreign matter is absorbed and applied to the growth of the cell or its embryo progeny; the other of disintegration or decay, by which the cell gives back to the outer world part of the material it had absorbed, and which is the necessary result, or rather, we might say, the supporting cause of the former action, since it is by the destruction and expenditure of force leading to this decay that the first action is accomplished. Both of these actions are necessary to the continuance of "life." No vital function, no act of assimilation or growth can go on without its corresponding expenditure and death, and just in

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* In the dry plate process the actinic force *seems* at least not to be converted into chemical action until the developer is applied. So also in the other examples of "bottled light."

† Andrew Cross was accustomed to charge his batteries of Leyden jars during a thunder storm with the *lightning* brought into his laboratory by the system of wires running over his estate, and then use the fluid for experiments of deflagration, etc.

proportion to the amount and energy of the manifestations of life will be the extent of this destruction and death.

What is thus true of the simple cell is true of the most elaborately organized creature, whose body is, after all, only a vast aggregation of cells. As you know, in the growth of the human being, cell buds out or bursts out from cell, (varying in character in various parts, but each alike in its history,) and so builds up the body. Thus it is that the coral island grows, the little insect-like cells budding out upon each other until the complete creature—for so we may fairly consider it—stands a beautiful embodiment of its name—κορη, girl, ἁλιος, of the sea—a sea nymph resting her white feet upon the yellow ocean bed, and wreathing her brow with sea-shells and twining weeds. And so it is with the more curiously constructed body, in which also there must be a constant death as well as an ever-recurring birth. The heart makes no beat which is not the death-stroke of some of its particles—no limb moves but a portion of its muscle dies—no thought passes through the brain that does not bear a death-warrant to some particle of its structure. Not only do we "die daily," but hourly, moment by moment, in part at least of our structure; and, strangest of all, we *must* so *die* in order to *live*, for the life-action consists in nothing but this—the constant and constantaneous processes of construction and disintegration. So long as the first predominates, life reigns; when the latter process becomes the more rapid, life vanishes. Having taken this general view of the characteristics of an organized body, let us observe a little more closely the way in which this action of birth and death is conducted.

The nutrition of the cell is the result of a chemical union between inorganic atoms, brought about through the agency of the vital force; the reversal of this, or the solution of this chemical union, constitutes the action of disintegration or decay. The liberated atoms may, and often do, form new combinations among themselves; but this is aside from our present subject, having no connection with the organizing power. To accomplish such actions it is clearly desirable that there should be among the atoms employed some possessed of a power of change, as regards their chemical affinities, a capacity at one time of strongly attracting, and at another of easily abandoning other substances: of seizing upon foreign matter to supply their growth, and of yielding it in course of their partial or ultimate decay.

Passing now to the particular case of the animal system, we find one of its most important constituents to be its circulating fluid or blood, in which, no less by modern discovery than by inspired teaching, are we led to look especially for the mystic life. Let us see what this fluid is called upon to do, and so, what sort of material it may require for its work.

This blood is, first, to nourish and support all parts of the complex fabric. It is to carry to the exhausted muscle, material for its renewal; to the bone, solid stone blocks, for building and for repair; to it the throat (that lute, whose strings are always being worn out and replaced, yet are never out of tune) looks for its new cords; to it the eye looks for new lenses, and the ear for new fittings for those shell-like chambers in which the nymph of harmony conceals herself. On its crimson tide float ever whole navies of laden argosies, filled with the most various commodities. Food for all tissues, supplies for all organs, materials for all structures, form their various freight. Nor is this duty all. This same current must not only be the bearer of food and raiment to the inhabitants of its shores, but it must also be like the Ganges, their burial-place. It must carry off the dead bodies of those cells which, having done their work, have by and in that very act terminated their existence. As has been beautifully said in this connection: "It must be at once like a fertilizing Nile, strewing life along its shores; and like that same river, when stricken by the rod of Moses, a bloody river of death, hurrying off the carcasses of its dead inhabitants to the sea."

To meet these requirements, as before, we here again need particles of wide, various, and varying affinities; and also, if it may be, some which shall be able to change, from time to time, their own characteristics, so as to present themselves in an agreeable form to many of those organs, which are so greedy each of its own peculiar condiment, so indifferent to that of all others.

Looking at the structure and maintenance of each other part, we see the same demands repeated: from the solid bones, which yet, for all their solidity, are always needing and receiving repair, to the fragile brain, which a touch would destroy, which every thought in part annihilates, and which yet builds fabrics which will outlast the pyramids, the earth, and all but eternity itself.

In all there is the same demand for a material which shall possess powerful and far-reaching affinities; which shall be capable of exciting in two precisely opposite states, as regards these affinities—now hating what it before loved, now abandoning what it before seized, now clinging to what it before rejected; and for one which, by its capacity of more than fabled metamorphosis, may fit itself to the various desires of a hundred strange and eccentric palates.

These being the demands of a material which is to constitute an organized being, let us now see if phosphorus fulfills them.

Has it powerful affinities for a large class of substances? This we can answer by experiment. You know that, as a general rule, substances do not combine in the solid state without intimate mixture; yet so powerful

is the affinity of phosphorus to iodine, for example, that even in the solid state, in large lumps, they will combine vigorously, as here, where I throw these fragments of iodine upon this piece of phosphorus, and their combination is so vigorous as to end in combustion.

Here again, observe the dazzling light which accompanies the union of phosphorus with oxygen, and which bears witness to the energy of their affinity. So also is it with all the elements which resemble these, the electro-negative class; phosphorus unites with them all: nor only with these; in like manner with the very opposite class, the electro-positive elements, such as hydrogen and the metals. Thus, if I throw into this glass of water these fragments of phosphide of calcium, the phosphorus of the compound will combine with the hydrogen of the water, forming the gas phosphuretted hydrogen, which you recognize by the fact that each bubble as it rises to the surface bursts into flame spontaneously, with the production of a beautiful wreath-like cloud of smoke. Phosphorus, also, as has been said, combines with the metals. We have its compounds with aluminum, calcium, magnesium, lithium, iron, cobalt, tungsten, manganese, copper, lead, and many others, and in time shall probably find that it combines with every element.

We may then most confidently assert that phosphorus fulfills the first of the required conditions, or has powerful and widely extending affinities.

But does it fulfill the second condition, of existing in two opposite states as regards these affinities—one active, the other passive; one of acquisition, the other of abandonment? This question, also, I can answer by experiment. The properties of phosphorus in its ordinary (which is its active) condition are already familiar to you. You know how it fumes and glows in the air; how the least friction, or a little warmth, ignites it; how it is a poison fatal in doses of a couple of grains. Here, however, is a piece of pure phosphorus which does *not* fume or glow in the air; may be *powdered* without igniting; will not take fire until heated to 570°, and has been swallowed in doses of two *ounces* without the remotest ill effect. Its affinities, following them out in detail, are just what this general summary would indicate—feeble, undemonstrative; it combines not at all, or slowly and reluctantly. Yet this is simple and pure phosphorus, and may be converted into the ordinary variety by simply heating it above 570° in some non-combining gas. It is formed by heating ordinary phosphorus for 40 hours to 464°–482°, in a non-combining gas, by the action of iodine on melted phosphorus, and by the continued action of light on the common form of this element. Here then again our question is affirmatively answered, and we see that this substance is capable of two opposite states with respect to its numerous chemical affinities.

In the next place, then, we ask: Is this body capable of great and numerous modifications of form?

Let me again answer this by practical illustration. Here I have a piece of freshly prepared phosphorus of the common form; it is, as you observe, transparent, of a faint yellow-brown color, very much like a piece of dirty glass, with no crystalline structure. Here again is another piece, opaque and white, like white wax; this, however, is also pure phosphorus. Here again is a piece, opaque and black, like plumbago; this also is the same body, pure and uncombined. Here again I have a mass of regular crystals, here a crimson powder, here a metallic lump; each and all being simply phosphorus, and phosphorus alone. Looking at these so different forms, may we not well say that phosphorus is able to change itself to meet the various requirements of many different organs?

Nor does phosphorus in its uncombined condition only exhibit these properties. Its most important compound, phosphoric acid, is similarly well suited to the changing wants of a changing structure. Thus it is capable of three forms. It may be monobasic, combining with and being neutralized by one equivalent of base; or it may be bybasic, requiring two equivalents of base to neutralize it; or it may be tribasic. Thus in the blood of a young growing animal it might, in its last form, take up three equivalents of lime from the nutritive apparatus, convey these to the bones, there deposit two equivalents where they were needed, and return; yet completely neutralized and deprived of all acid properties (which might seriously injure that fluid) through the circulation, with only one part of the earthy base. This acid is also at once the most powerful and the mildest of acids. It can wring from the fierce oil of vitriol and the violent aqua-fortis, the water which they so long for, and so thirstily swallow; and yet it may be spread upon the skin without injury. When thrown into water, it at first hisses like hot iron, with the vigor of its combination; but then, when it has been reduced to the condition of half melted snow, it very slowly dissolves. As the author before quoted has said: "It is like a feverish child that begs for a great big bowl of water, and then just moistens its lips." In fact, this is the very acid of acids for an organized structure.

We may now, I think, admit that phosphorus, in no small degree, fills the demands expressed by organized structures, as regards their elementary materials; and our last question only remains to be answered, *i.e.* What other element resembles it, and how far?

The element, beyond question, most closely allied to phosphorus is arsenic. The chemical properties of these substances are indeed wonderfully alike, and many of their compounds are hard to distinguish. The affinities of both have a very wide range, and run in the same direction.

They are both poisons, and nearly equal in degree. Both are irritants; both in medicinal doses are stimulants; both form garlicky gaseous compounds with hydrogen; both form acids of three forms, not to mention other points of general and special analogy. But with all this resemblance there is one great point of difference; a point of vital importance in the present connection. Arsenic *has no amorphous form.* It is no fierce lion, terrible in its native ferocity, yet capable of being tamed, and even domesticated; but is rather a cruel snake, deaf to all charms, fatal to any bosom that may harbor it. Thus it is evidently unfitted for such an office as that of phosphorus in the animal economy; and being able to exist only in its active form, can perform only active functions in the organism, and being unable to lie there in a quiescent state, must do some mischief to the structure if introduced in any but minute portions. It has been stated (and in popular works the statement has received extensive circulation) that arsenic may by continuous use become a harmless, or even beneficial element in the human system. Such a statement is, however, without satisfactory circumstantial foundation; and utterly without support of experiment and observation. The history of this curious error is as follows. In 1854 a certain Dr. Von Tschudi published, in the *Journal de Chimie Médicale,* an account of an alleged habit of eating arsenic, indulged in by the peasants of Styria and Hungary. The poison was stated to be taken in gradually increasing doses, varying from part of a grain to two or three grains, every few days. It was resorted to by the women to improve their complexions, and by the men to increase their strength. Many strange and pathetic stories, generally without date or location, were added; and it was explained how at last the arsenic-eater must reach a point when to pause, retreat, or advance was alike fatal, for the practice, once established, was a necessity, to abandon it being the occasion of death, with all the symptoms of arsenic poisoning; which, however, did not appear if the dose were regularly taken and regularly increased, ("being graduated according to *the phases of the moon,*") until an amount was reached which must prove a poisonous dose even to an arsenic-eater.

Publicity and authority was first given to this wonderful statement by Prof. Johnston, in his Chemistry of Common Life, and from thence it has journeyed far and wide in popular literature.

To most of our readers the "moon phase" of the proposition (Tschudi's own expression) would, we imagine, be conclusive as regards the value of the whole statement. But we may add, that extended medical observation and experiment have proved that the systems of the inhabitants of England and America, so far from accustoming themselves to large doses of arsenic by a gradual increase, become, on the contrary, more and

more sensitive to the same, or a diminished dose; so that in medical use the full dose, one-eighth of a grain, should be given at first, and then *decreased* if continued.

There is, moreover, reason to suspect that the substance seen in use by Tschudi, if any, was oxide of zinc. The question was revived a few years since, in a lecture delivered in one of the London hospitals, where the lecturer brought forward some letters from a superintendent of mines, and others in Germany, alleging the existence of the practice; but here the evidence proved too much if admitted, for it was distinctly stated that the first dose recommended and taken to begin the progress was of three grains, *a full fatal dose*, in this part of the world at least.

We see, then, that in answer to the demands made by organized structures, phosphorus presents an array of properties wonderfully adapted to such requirements; and that it alone, of all the elements, possesses at once all these needful powers. Seeing, moreover, how large a use is made of this substance in organized creatures, it must be very evident to us that here, as elsewhere in the great workshop of nature, the material employed is the best adapted, as is the tool used the most efficient, for the structure to be produced.

Dr. McQuillen said that, in connection with the admirable paper just read, he would direct attention to the fact that according to Liebig the acidity of *urine* is due to the presence of the acid phosphates in that secretion. Some of these phosphates are derived directly from the food—animal and vegetable—but a very large proportion is due to the decomposition of the osseous and other tissues, especially the brain and nervous system generally. The phosphorus derived from the latter source is supposed to unite with oxygen and then combine with bases.

The quantity of phosphates present is liable to considerable variation, and it is well known that any unusual demand upon the nervous system, such as undue exercise of the mind, and all circumstances producing nervous exhaustion, is accompanied by a marked increase. Even in the normal action of the brain attendant upon an unusual but not exhaustive mental effort, the wear and tear of nerve tissue is made manifest by the additional amount of phosphorus in the urine; the most conclusive evidence of the truth of this is afforded by clergymen, with whom the periodical demand upon the mental powers in the preparation for and discharge of their clerical duties is followed by such results.

His principal object in rising, however, was in relation to the pathoogical rather than the physiological effects of phosphorus on the human economy. He referred to that peculiar and destructive disease known as *phosphor-necrosis*, in which the maxillæ of operatives employed in the manufacture of lucifer matches are liable to be affected by the action of

phosphorus to such an extent as not only to induce necrosis and exfoliation of the bones, but also to result, in some instances, in the death of the patient.

Several years ago the subject engaged considerable attention in Germany and England, where quite a number of cases were reported. Very few cases have occurred in this country, or at least have been reported in the medical journals. One of these, in which the inferior maxilla was removed by Dr. Halsey, had come under his notice.

There are several stages in the manufacture of the matches, some of which are harmless; but all those involving the presence of phosphorus are regarded as more or less *dangerous to persons who have carious teeth. No case, however, has been reported in which those possessing perfectly sound teeth have been attacked by the disease.*

The affection manifests itself first by pain limited to a carious tooth, which eventually extends to the whole jaw, and over the cheek, temporal region, and neck. This is accompanied by swelling of the gums and cheek, with erysipelatous redness of the latter; an abscess soon forms, and discharges fetid pus into the oral cavity, or it may open upon the cheek and discharge externally; a sinus being established, the livid gums retract from the jaw, and the teeth become loose and fall out; the disease progressing, more sinuses form, through which the necrosed bone can be reached by the probe. The affection may terminate in exfoliation, or extend and involve the soft parts, until death terminates the scene.

From carefully recorded statistics it appears that the liability of the inferior maxilla to the disease is greater than the superior. And a marked peculiarity of the disease is that the alveolar process, body, and rami of the necrosed lower jaw are invariably more or less invested by a morbid product, increasing in thickness from above downward. In the upper jaw no new substance appears to be deposited.

When the disease obtains much headway, there is very little if any chance of saving the affected bone. Such being the case, it is important that attention should be paid to prophylactic or preventive measures. Care should be exercised on the part of the manufacturer to see that the teeth of those in his employ are either perfectly sound, or that all those affected by caries are placed in a proper condition by the dentist.

It is generally supposed that the *phosphoric fumes* present in some departments of the manufactory, the drying-room in particular, are the active agents in developing the affection, and this view appears to be confirmed by experiments performed by Dr. von Bibra on rabbits, which were exposed to the fumes of phosphorus in a wooden box after the jaws had been fractured in the effort to extract the molar teeth. The animals lived about eight weeks, and on a post-mortem examination the jaws

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were found in a condition somewhat analogous to that presented by the jaws of persons who have suffered from phosphor-necrosis.

Prof. Morton stated that certain factories in England had employed amorphous phosphorus for the manufacture of "the patent safety match;" these, however, have not come into general use, since they can be ignited only by striking them upon a peculiar paper made for the purpose.

Dr. Flagg said that he believed it was not alone in the drying rooms of match factories that danger of excitation to phosphor-necrosis was incurred, but in every department of this or any other establishment which exposed the manipulator to the fumes of phosphorus or to actual contact between the material itself and the *maxillary* periosteum. He knew nothing in relation to this matter as the result of his own experience in practice or by experimentation, but communications upon this subject seemed to indicate it as of especial interest to the dentist, in that the maxillæ *alone* were selected as the location for manifestations of disease. He had *seen it stated* that even when fistulæ existed communicating with periosteum in other portions of the economy, the contiguous osseous structure seemed exempt from contamination. Thought that while the connection of phosphorus with investigations in this direction was deeply interesting, yet it was more so theoretically than practically, for the predisposing causes were so well understood that such preventive measures had been instituted in the matter of dental examinations, etc. as had almost entirely precluded the possibility of the occurrence of this terrible affection. He called to mind the peculiar recuperative energy which the periosteum usually exhibited after the performance of that enucleation of devitalized bone which was regarded as the proper operation in phosphor-necrosis, and which therefore called for the utmost care in its preservation at the hands of the operator. He would refer briefly to the connection, in the matter of teeth, odors, etc., which had been alluded to in the paper for the evening, between phosphorus and arsenious acid, and would notice the similarity which also existed in their action when induced locally or constitutionally, in the former as extensively destructive of vitality, and in the latter as extensively productive of invigorating influences. He would mention the free administration of carbonate of magnesia in water as the antidote to the effects of swallowing phosphorus. He desired at this time to repeat that which he believed he had alluded to upon the floor of this Society at some previous meeting, but which seemed to have an immediate connection with the subject under consideration, and to possess sufficient practical importance to warrant its presentation; he had reference to the exhibition of phosphatic salts during the periods of infantile and second dentition. He had frequently been instrumental in producing much alleviation from irritation and restoring the necessary

vigor to systems which seemed incapable of otherwise supporting the febrile exhaustion concomitant with the process of first and second teething, by the use of the phosphates of iron, lime, manganese, potash, etc. combined with such stimulants or sedatives as seemed individually indicated.

Dr. McQuillen said he doubted very much the accuracy of the opinion that phosphorus has a decided affinity for the maxillæ in preference to the other bones of the body. It is owing to the fact that the agent is brought *directly in contact with the periosteum of the maxillæ* by carious teeth that the disease is developed, and it is reasonable to infer that under similar circumstances other bones would become affected. Two or three years ago he was on the eve of instituting a series of experiments on animals to determine this point, but permitted the opportunity to pass by without making the attempt.

Dr. Kingsbury remarked that he had listened with deep interest to the essay of Professor Morton, also to the discussion elicited. The subject, in its relations to our specialty, commended itself to our consideration, and was well worthy of the most careful and thorough investigation of every dental practitioner. Although it was in some of its aspects a highly *luminous* subject—as had been clearly demonstrated by the numerous and beautiful experiments of the evening—it must be conceded that in other respects it was involved in mystery and darkness. He referred to the various and contradictory opinions entertained by pathologists in regard to the action of this subtle and powerful agent in producing what is known as phosphor-necrosis, and the difficulty experienced in satisfactorily explaining the rationale of its specific effects.

That most useful invention—the lucifer match—has revealed to us the singular and destructive influence of the fumes of phosphorus. As had been already stated, the attention of European physicians was first called to this subject, yet he remembered to have read an interesting account published in the *New York Journal of Medicine* for May, 1856, by Dr. J. R. Wood, in which he gave the history of a case of this species of necrosis, where he removed the entire inferior maxillary bone for the cure of the disease. That was the first case brought to the notice of the medical and dental profession in this country. A number of cases occurring in the match factories of this country had been reported, he believed, since that. Whether the destructive effects of phosphorus were due to the fumes coming in direct contact with the periosteum, or alveolar process, or to its absorption into the system, and thus acting constitutionally in the same way as mercury, was a question difficult to solve. Perhaps it acted both locally and constitutionally. There were strong reasons to believe such was the case. Dr. von Bibra attributed its injurious effects to the hypophosphorous acid produced by the oxidation of the vapor of

the phosphorus. In whatever manner the specific effects were produced, inflammation of the periosteal membrane was followed by its destruction and sloughing, and necrosis of the bone was the inevitable result. Proper prophylactic measures would no doubt do much to avert the dire consequences to the workmen engaged in the manufacture of lucifer and congreve matches. The Austrian government requires the employees of the lucifer match factories to wash their mouths frequently with acidulated water. In an extensive factory of congreve matches in London, the workmen wear sponges before their mouths, and use a solution of soda for washing their hands. The proprietor states that since the adoption of these preventive measures, in connection with thorough ventilation, not a single case of phosphor-necrosis has occurred among his workmen. If regulations so simple proved to be such an effectual safeguard, he hoped for the cause of humanity that they would be speedily adopted, and faithfully enforced in all similar establishments.

Dr. Ellis said that the physiological properties of phosphorus had been thoroughly considered in the interesting paper just read, and the remarks subsequently made had embraced the main points in relation to its therapeutic powers, and its influence in producing the disease known as phosphor-necrosis. He remarked that the treatment of this affection had not been noticed, and as it is now, in connection with all other affections of the mouth, jaws, and their appendages, claimed by and accorded to the dental practitioner, it behooves us to be familiar with its peculiarities. He knew that cases of extensive syphilitic necrosis had been successfully treated by the dentist, but whether a case of phosphor-necrosis had ever fallen into the hands of a member of our specialty, he was unable to say. The surgical treatment of phosphor-necrosis was the treatment of necrosis from whatever cause or causes it may arise; and in connection with the subject, there has arisen much argument relative to the bone-reproducing function of the periosteum, some contending that to that membrane alone are we to look for secondary osseous formation, while others believe all tissues capable of effusing a plasm susceptible of osseous organization. It may be that both are right, and that both sources contribute toward such a result. Prof. Gross, in his work on surgery, regards the question as unsettled, and states, as the result of personal observation, "that the perfection of the new bone will generally be found to be in proportion to the integrity and activity of the periosteum." Dr. Atkinson, of New York, who has had considerable experience in the treatment of necrosis of the jaws, advocates the retention of the periosteum, so far as practicable, when the removal of bone is necessitated, in order that it may act as a pouch to retain the plasm, and insure its organization in a form closely approximating the natural contour.

At the close of the discussion, Dr. Tees presented, for examination, Dr. Henry's improved vulcanizing flask, designed to allow the surplus matter exit without endangering fracture of the blocks.

Drs. Flagg, Gorges, and Tees were appointed a committee to examine and report upon its merits.

Dr Haywood exhibited his improved manner of securing blocks to vulcanite base.

Upon motion, adjourned.

THE Society met in the Philadelphia Dental College on Friday evening, February 5th, 1864, at 8 o'clock, with Prof. Morton acting as President *pro tem.*

Dr. R. Shelton Mackenzie returned thanks for his recent election as an honorary member of the Society, expressed a warm interest in its welfare, and trusted that it might be in his power to do something in its behalf.

Dr. McQuillen said that he was in receipt of letters from several gentlemen, acknowledging their election as members of the Society.

Dr. Flagg then presented the following works to the Society: "Fitch's System of Dental Surgery;" "Bell on the Teeth;" "Odontalgia," by S. Brown; "Harris' Characteristics of the Teeth and Gums;" "Godman's Addresses."

They were received, and a vote of thanks tendered the donor.

The committee on the death of Dr. Leibert made the following report, which was received, and the committee discharged.

MR. PRESIDENT:—Your committee beg leave to report that they have attended to the duty assigned them, viz.:—

WHEREAS the members of the Odontographic Society of Pennsylvania have heard, with deep regret, of the decease of their fellow-member, DR. H. LEIBERT, a gentleman who took a warm interest in the establishment and prosperity of this Society,

Resolved, That, falling a victim, as he did, while engaged in scientific investigations, his death is of more than ordinary interest to those who devote their energies in such directions.

Resolved, That in his death the dental profession has lost a valuable and conscientious practitioner, who, when a student, devoted himself assiduously to the study of his profession, with the view of occupying an elevated position in its ranks.

Resolved, That we tender to his bereaved family our sympathies in this their hour of affliction.

Resolved, That a copy of these resolutions be transmitted to the family, and that they be published in the "Transactions."

J. H. McQuillen,
Henry Morton,
Geo. W. Ellis,
} *Committee.*

The following paper was then read:—

"NERVOUS AFFECTIONS ORIGINATING FROM DENTAL DISEASE."

BY GEO. W. ELLIS, D.D.S.,
DEMONSTRATOR OF OPERATIVE DENTISTRY IN THE PHILADELPHIA DENTAL COLLEGE.

Gentlemen:—You no doubt recognize the title as embracing an extensive, interesting, and intricate matter, worthy of investigation and promising the searcher after knowledge entertaining and profitable study. I am equally cognizant of its importance, and hence hesitated in adopting it as the subject of my evening's essay, knowing the impossibility of giving it anything more than the most superficial consideration in so limited a space. Yet it is upon such topics that we need enlightenment; and, since this can be obtained in no better way than by a comparison of views in a discussional society, I resolved to start the ball moving, hoping that the efforts to keep it in motion might develop our skill, improve our tactics, and enable us to play a winning game with our subtle adversary.

The most active members of our specialty have long labored to overthrow the barrier which prevented us from assuming control of such systemic difficulties as were clearly referable to a dental origin; their efforts have at length proven successful, and it is a source of gratulation and pride that the unjust imputation upon the ability of our profession is removed, that it is afforded a wider scope for the exercise of its humane and comforting mission, and that it is daily increasing its claims to confidence and respect.

In coming, however, to the subject proper, it is difficult to find the exact starting-point, although, in speaking of nervous affections, a cursory glance at the general anatomical and physiological properties of the nervous system would seem to be eminently proper.

We would notice its division into the cerebro-spinal system, which embraces the brain, spinal cord, and their branching nerves, with their ganglia; and the ganglionic or great sympathetic system, which consists of an intricate network or plexus of nerves, radiating from a chain of ganglia situated along the spinal column, and provided with numerous ganglia throughout their course. The former system presides over the intellect, the special senses, volition, and sensation, and has been termed

by Bichat the "nervous system of animal life;" while the latter, from regulating nutrition, secretion, etc., was termed by him, in contradistinction to the former, the "nervous system of organic life." These two systems, however, are not entirely and totally distinct, but frequently join in distribution to the same organs, endowing them with a double nervous influence, so necessary to the proper and uninterrupted performance of their functions; and secures by this intermingling the beautifully concerted and harmonious action of the various organs and tissues which compose the human structure.

The nerves, however, perform widely different offices, and hence have received different and appropriate names. Those constituting the media through which cognizance is taken of impressions upon any of the organs of special sense, have been termed "nerves of special sense;" such as contribute to sensibility are denoted "nerves of common sensation;" such as conduct the motor influence are termed "nerves of motion;" and such as combine the two latter properties are called "mixed nerves." The sentient nerves possess the power of carrying stimulus to a ganglion, where it is converted into motion, and transmitted through motor nerves, either directly to the part from whence the stimulating influence originated, or over an extended surface, according as the producing cause be mild and of short duration, or stronger and more persistent in its application. This constitutes what is known as reflex action, which, in the cerebro-spinal system, is classified by Dalton as follows:—

First. That of the spinal cord, where the nervous impression is conducted directly to that organ, and being there converted into a motor influence, is conveyed to the muscles without any necessary connection with consciousness or will-force. This is termed reflex action *par excellence.*

Second. That in which the impression, passing beyond the spinal cord, reaches the tuber annulare, where it is appreciated by the intellect; the resultant action is voluntary in its character, and follows instantly upon the receipt of the impression without any exercise of the reasoning powers, and hence has been termed *instinctive.*

Third. That in which the impression is carried still further, entering the cerebrum and generating a reasoning process, by which the subsequent action is regulated.

The same author also recognizes three kinds of reflex action, which occur wholly or partially through the agency of the sympathetic system, and in which the viscera and involuntary muscles are in some way implicated. These are the general anatomical and physiological points in reference to the nervous system, without going into detail; and, thus far, our best authorities are found to very closely coincide. With regard,

however, to the nature of "nerve-force," the facts are not so apparent; and the difficulty experienced in solving the mystery is evinced by the conflicting character of results obtained through the accurate and laborious investigations of our best physiologists. For instance: Dalton, in reply to some ingenious statements designed to establish the identity of electricity and nerve-force, makes use of apparently very plausible arguments to show that, although similar in some of their properties, they are widely dissimilar in others, and that the latter force is peculiar to nerve structure, and capable of generation by it alone. On the other hand, the carefully conducted and laborious experiments of Smee demonstrated the existence of an electric current in nerves. Du Bois Reymond obtained like results; when such concurrence in the views of two so reliable authorities enlisted in favor of the electric theory a number of worthy advocates, the detection and analyzation of this powerful, all-important, and lightning-like force would enable us to understandingly combat these trying and excruciatingly painful affections. Although many well-directed and persevering efforts have been baffled, we believe that, from the untiring exertions of those noble devotees of science who are expending life and energies for the benefit of the human family, some good will ultimately accrue, some light be eliminated which will illuminate the obscurity, and enable the professional man to render submissive and docile those nervous diseases which frequently prove so rebellious and persistent.

From this brief description of the nervous organism, it can be readily appreciated how, through the intimate blendings and interchangings of the various filaments, an irritant, applied to one part, can make its effects apparent in another quite remote, either in the form of sensation or motion; and thus, without being guilty of the fault of too many specialists, of attaching an undue importance to the organs with which we have to deal, pathological conditions of the teeth are capable of producing almost any of the nervous disturbances, as manifested in headache, syncope, convulsions, neuralgia, hysteria, epilepsy, tetanus, palsy, insanity, amaurosis, deafness, otalgia, etc.

Philosophers are supposed to be men of judgment and reason; and if

> "There never yet was a philosopher
> Who could endure the *toothache* patiently,"

what is to be expected of less gifted mortals when attacked, not only with this unbearable malady, but simultaneously with one of the concomitants just mentioned? Should we not deeply sympathize with them in such complicated affliction, and press into the service every palliative and curative likely to minister to comfort and restoration? How many, who are intrusted with the treatment of affections such as those just enumerated,

are sufficiently impressed with the importance of the teeth, to attach to them even so much as the shadow of a suspicion, in their search after the exciting cause, rather look everywhere else, and neglect this fruitful source of trouble! When we take into consideration, however, that medical instructors generally regard diseases of the teeth and their treatment as matters of minor importance, it is gratifying to occasionally meet with general practitioners who recognize the systemic disorders as fugitives from the oral Pandora casket, whose precious pearls so often become the germs of evils almost as numerous as that mythological receptacle is supposed to have harbored. To notice some of these ailments, and cite a few illustrative cases, will confirm the agency of the teeth in originating nervous affections.

That which will first receive our attention is cephalalgia, or headache, which is so common an attendant upon toothache that its absence might be regarded an exception. It may exist in any of its various forms, the pain being limited to a small surface, diffused over the entire head, confined superficially, or extended deeply into the brain. Remedies successfully addressed to the offending tooth will mostly result in the simultaneous cessation of the symptomatic pain in the head, although the administration of a narcotic or nervous stimulant, cooling or sedative applications to the head, and the gentle approach to the nostrils of some pungent and stimulating vapor, will prove advantageous adjuncts. Dr. Wood advises, in every case of obstinate cephalalgia of uncertain origin, that particular examination be made into the condition of the teeth, and any one found decayed and tender on pressure, be extracted. He says: "I once had a case of headache, which had continued for two or three months, with varying degrees of violence, and had resisted numerous remedies, which yielded immediately upon the extraction of some decayed teeth." Although we would all heartily indorse the advisability of dental examinations in such cases, there would arise many dissenting voices to the practice of removing all teeth "decayed and tender on pressure."

Another nervous difficulty likely to result from dental irritation is syncope, occasioned mostly by the contact of an instrument with an exposed pulp, cutting upon exquisitely sensitive dentine, the apprehension of a painful operation, or the depression consequent upon its performance, hæmorrhage, etc. I remember the case of a gentleman who applied for an examination of his mouth—the approach of the hand alone, unarmed with an instrument, was sufficient to produce syncope. On recovery, the attempt was renewed, with a like result, until, somewhat mortified, the patient resolved to postpone the operation until some future time, when he hoped to undergo its performance with more fortitude. Some individuals, from idiosyncrasy, are unduly impressed with the sight of blood, the slight-

est wound being sufficient to induce an attack of syncope. In such cases as these, however, reaction soon takes place without any interference, yet, from the trouble and detention which they occasion, they prove very undesirable patients, and, fortunately for the operator, very rarely present. When the attack is caused by any acute pain, palliatives should be employed for its mitigation, and means afterward taken to prevent its recurrence; if it be produced by the sensitiveness of an exposed pulp, morphia should be applied, to reduce the sensation, when arsenic, in some form, may be used for its destruction; if from hyper-sensibility of dentine, care should be taken to reduce this before an attempt at excavation. Chloride of zinc is, in the majority of instances, a very reliable agent, although creosote, tannin, chalk, carbonate of ammonia, etc. have each their advocates. When everything else has failed, however, there are still two *reliable* remedies—the performance of the operation under the influence of an anæsthetic, or the application of arsenical paste. When the latter plan is resorted to, care should be exercised, in order to prevent its penetration to a depth sufficient to occasion death of the pulp. Syncope, from any of these causes, demands the same treatment. It is generally sufficient to place the patient in a reclining posture, with the head on a level with, or a little lower than, the rest of the body; loosen all confining articles of dress; apply some pungent volatile liquid to the nostrils; favor reaction by sprinkling cold water upon the surface, friction with coarse towels, slapping, etc. The administration of diffusible stimulants, the application of intense heat to the spine, the use of electricity, etc. are resorted to in extreme cases, such as seldom fall within the province of the dentist.

Convulsions, another form of nervous disorder brought frequently to the notice of the dental practitioner, are limited chiefly to children during the eruption of the temporary teeth, the nervous system being at this period in a peculiarly susceptible and delicate condition. There exists, however, a great difference in the predisposition to such difficulty, one child enduring influences which in another would occasion convulsions of the most alarming character. The gums should be first examined, and if there be indications of an erupting tooth, the part must be freely opened by an incision extending down to the crown; the operation is generally a painless one, and the child once relieved, instinctively covets its repetition at the first indication of a recurrence of the difficulty. When a continuance of the convulsions is threatened after this operation, a pair of blisters, applied behind the ears, is the treatment recommended. Cases, however, demanding general tonic treatment, the employment of antispasmodics, etc., will pass into the hands of the general practitioner. I would mention here that some gentlemen have employed the various

phosphates with the most happy results, mitigating the pains of dentition and contributing to a superior quality of tooth structure.

Neuralgia is a subject of special interest to the dentist, and one which merits a lengthy consideration; but the character of this paper forbids anything more than a general review of its nature, in connection with diseases of the teeth. Any pathological condition of these organs is liable to occasion pain in the various nerves distributed over the head and face, which differs in duration, intensity, and extent, according to the same conditions in the exciting cause. Exposure of the pulp to sudden changes of temperature or the contact of foreign bodies, and exostosis, constitute probably the most prolific sources of its excitation. With regard to the peculiar condition of nerve tissue, in cases of persistent neuralgia, very little definite information is possessed; and the many efforts to discover its cause have met with nothing more than the most limited success, some pathologists considering it the result of inflammation of the nerve tissue or neurilemma, while others regard it as exclusively functional in its character. A few years' dental practice will generally serve to bring some cases of this kind to notice; and when the teeth are suspected as the originators of the difficulty, considerable care and discrimination are requisite to fix with certainty upon the offending member. The trouble will sometimes cease upon the correction of the local difficulty, but more frequently a morbid condition of the neighboring nerve tissue is inaugurated, which we are obliged to meet with the various remedies pronounced efficacious in such diseases. The mode of treatment most lauded is the administration of tonics and stimulants, in conjunction with narcotics, which are sometimes absolutely essential, in order to render the pain tolerable. Of the former, the chalybeates are mostly preferred, especially the subcarbonate of iron, combined with some narcotic extract. When there is a periodicity in the paroxysms, they will generally yield to the influence of some of the antiperiodic remedies. During the treatment of facial neuralgia, the employment locally of narcotic remedies, in the form of ointments or washes, will not only diminish the violence of the pain, but will sometimes alone prove curative, probably by enabling the nervous system to recuperate from the debilitated condition occasioned by continued suffering.

Hysteria is another form of nervous disorder, the predisposition to which is supposed to exist in an increased and morbid excitability of the nervous system, the slightest irritating influence being, in many cases, sufficient to provoke all its peculiar phenomena. It is considered by some as strictly a female disorder, having its origin in a disturbance of the uterine system; by others, as traceable to disorder of the brain, etc.; but the best authorities ignore any exclusive theory—discover it in the male

as well as female—and attribute it to the general cause just mentioned. I recall a case which occurred in practice several years since. A lady, of hysterical tendency, was undergoing the operation of excavating an upper incisor, previous to filling; the instrument coming in contact with a sensitive surface, gave rise to an attack of the most alarming nature, although the statement of a friend who was present, to the effect that it was nothing unusual, served to allay all apprehension. I am knowing to the case of a lady where the dread of a dental operation is sufficient to occasion a paroxysm.

When a tooth is discovered to be the exciting agent, measures should be taken to correct its condition; and the general nervous irritability must be reduced by tonic treatment, wholesome nutritious diet, exercise in the open air; in other words, the avoidance of everything calculated to reduce the health and strength, and the adoption of all measures expected to impart tone and vigor to the system.

Epilepsy is a nervous disease, supposed to have its origin in a disordered condition of the brain, which renders it very impressible by causes which would otherwise pass unnoticed. This, like the other nervous disorders, may be excited by dental irritation, through the agency of the cerebrum; or such irritation may constitute the primary inducing cause. A case of the latter kind occurred in the past month of November, and was sufficiently marked to merit notice.

Miss M., a young lady aged about twenty years, of nervo-bilious temperament, was seized with violent epileptic convulsions, which continued for a week or more, with such intensity and rapid succession as to seriously threaten dissolution. Her attendant physician, Dr. Hay, suspecting the teeth to be in some manner provocative of the trouble, sent for me to make a dental examination. After a careful search, I discovered an upper molar decayed down even with the gum, and containing a very sensitive fungus pulp. Upon putting some leading questions, I was confirmed in the belief that here was located the cause of trouble. There was, however, upon the same side, a badly decayed bicuspid, with a rapidly developing abscess at the root; and the determination to extract both was the result of a very short deliberation. The patient was accordingly etherized, and both teeth removed. Although during my stay—which did not exceed in all one hour—there were four or five *violent* paroxysms, I have been informed by Dr. H. that immediately after the operation they became less frequent and intense, disappearing altogether in the course of a few days, under the alternate exhibition of quinia, combined with morphia and belladonna.

I am familiar with other cases in which the extraction of the teeth either diminished the frequency of the convulsions, or, as in the case just men-

tioned, arrested them entirely. One I recall of a young gentleman who was threatened with epilepsy, the tendency to which was entirely removed by the extraction of every alternate tooth, thus withdrawing the pressure occasioned by exostosis. After the removal of the exciting cause, the treatment consists in diminishing the morbid excitability of the brain, the tonics and narcotics combined constituting the remedies generally employed.

Tetanus and palsy, though almost directly opposite in their peculiar symptoms, are, nevertheless, both inducible by dental irritation, the former being most likely to result from violence done in the operation of extraction. A case is mentioned by Tomes in which it originated from a pivoted tooth; and a short time since I noticed a report stating the death of a child fourteen years of age, from trismus, caused by the continued irritation of decayed teeth. When the slightest tendency toward tetanic rigidity is manifested, active means should be taken to reduce or remove the irritant cause, and some of the narcotics administered, in order to soothe the general irritability of the nervous system; if, however, it become fully developed, opiates, tobacco, etc. must be used, ether or chloroform administered by inhalation, the spine cauterized, and stimulants exhibited when indicated by prostration.

Paralysis sometimes occurs in infants during dentition, and may prove trifling and temporary, or serious and persistent in its effects. When the latter is unfortunately the case, remedies possessing the power of exciting muscular action are mostly relied upon—such as strychnia, ergot, etc., and applications of electricity or galvanism. It may arise in the adult from very trifling causes, upon the removal of which the motor stimulants just mentioned are applicable. The nerves of special sense may become the subjects of paralysis; and amaurosis or blindness, and cophosis or deafness not unfrequently exist as the offspring of dental parentage. I remember a case of amaurosis, which occurred in the practice of a professional friend, where the patient, a lady, had been medicinally treated for some six months, without any improvement, until the discovery—for it was a *discovery*, requiring two or three close examinations for its detection—and removal of portion of necrosed alveolus, an operation followed by a gradual recovery of the lost vision.

Deafness, otalgia, and otorrhœa, either singly or combined, are not unfrequently the result of dental trouble. A case of deafness, with accompanying otorrhœa, came under my notice some time since, in which the removal of a dens sapientiæ, followed by the use of appropriate stimulant and disinfectant injections, speedily effected a cure.

It is unnecessary to multiply further these illustrations, for our dental and medical periodicals contain, in almost every issue, an account of some

nervous disorder arising from dental irritation, or a source as little calculated from its extent to generate disorders of such magnitude. It is worthy of mention, however, that diseases of the teeth occasion sympathetic disorder, not only of the nerves of special and general sensation and motion, but occasionally aim directly at the central and controlling organ, the brain, dethroning reason and rendering the unfortunate an object of care and commiseration. A case of this character was reported some time ago, in which a gentleman had been suffering for many years from supposed neuralgia, which finally terminated in insanity; and in this condition he was brought to his dental adviser for the extraction of a tooth. After the application of extraordinary force, the tooth was removed, disclosing an osseous tumor about the size of a filbert, which was growing upon the roots near the crown. The neuralgia ceased, and the patient was soon restored to sanity.

I designed, in treating the subject of this essay, to give it as brief a consideration as possible, yet, even in taking so general a view, the paper has attained to a greater length than I had intended.

In conclusion, I would say that, in connection with cases such as those described, too much stress cannot be laid upon the importance of *thorough* examination and *re*-examination, in order to detect the source of trouble, for the obscurity of the exciting cause is often sufficient to elude the closest scrutiny of the most experienced observer, and call for the expenditure of great skill and patience. With discovery, its removal constitutes the primary step in the treatment; after which the choice of remedial agents must devolve upon the judgment and discrimination of the operator, for the various accompanying peculiarities will determine the most desirable course, while the articles accredited with beneficial qualities are too numerous to admit of specification.

Dr. McQuillen said that, having been informed by the essayist of the evening what would be the subject of his paper, with the view of giving additional interest to the proceedings, he had concluded to present a few physiological experiments in illustration of that portion of the nervous system denominated by Marshall Hall the *true spinal or excito-motor*, and which, either as the result of *centric* or *excentric irritation*, is the agency through which all *convulsive movements* probably are produced. Very decided objections are frequently urged against such experiments on the ground of cruelty to the brute creation. These objections, however, lose their force when taking into consideration that such interrogations of nature have for their object the alleviation of suffering humanity, through the improved modes of treatment attendant upon the acquisition of a more perfect knowledge of the origin and nature of nervous affections. If animals may be destroyed for the sustenance of man, there

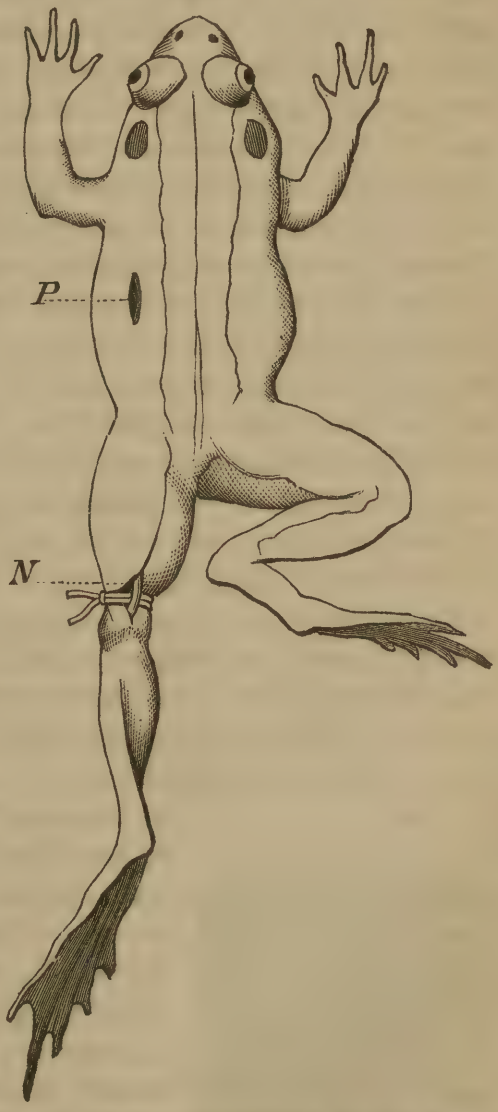
can be no just cause of complaint against investigations tending to eradicate or remedy some of "the ills which flesh is heir to;" particularly when, by the employment of chloroform or ether, the animals can be rendered insensible during the performance of many of the experiments. Prior to the time of Sir Chas. Bell, the views of physiologists, as is well known, were of the most opposite and contradictory character with regard to the functions of the various portions of the nervous system; but the vivisections of that eminent man, and the subsequent labors of Mayo, Magendie, Hall, Flourens, Longet, Bernard, Brown-Séquard and others in the same direction, have resulted in the establishment of important and reliable facts, which might be *inferred*, but could not be *definitely settled* in any other manner. Extended and valuable as the results of these investigations unquestionably are, it does not follow that the field is exhausted, or that the repetition of experiments already frequently performed may not eventuate in the discovery of important facts which have escaped the notice of preceding experimenters. Even admitting that such may not be the case, in this day it is not enough for teachers of physiology to detail the observations of others, but they must *experiment* themselves, and *demonstrate their experiments* to those whom they address. It is the recognition of this fact which induced him to work in such directions. The following experiments were then performed with most satisfactory and instructive results:—

First Experiment.—The body of a frog is here presented whose head has just been removed. Now, notwithstanding that physiologists generally agree that sensation is the perception of an impression, and that whatever may be its nature, it requires the intervention of the brain, you will observe on pinching the toes of this brainless animal, or applying nitric acid to the same parts, the extremities are drawn up to the body as if to get away from the source of irritation. Again, on applying the acid to the breast, the upper extremity of the side experimented on is brought toward the part as if with the view of removing the cause of trouble. In analogous experiments on alligators by Dowler, he found the *headless* trunk invariably rolled *away* from *rather* than *toward* the fire, sharp instrument, etc. Results such as these indicate not only the presence of sensibility, but also the capacity or power to act responsive to the stimuli. The spinal cord, as a great ganglionic centre, is the point where such impressions are received through the *sensory* nerves, and from which the motor influence is sent along the *motor nerves* distributed to the muscles. When the manifestation of sensibility, already demonstrated, ceases in response to such stimuli, you observe the electric current induces the most decided spasm. This occurs not merely when the extremities are connected with the trunk, but after a limb, as the one

here shown, (fig. 1,) is severed from the body; thus, on applying the current to the *sciatic nerve*, a portion of which has been dissected out, you see the decided and repeated spasms induced; and yet several hours have elapsed since the limb was cut from the body. These spasms demonstrate in a marked degree the *irritability* of the nervous tissue, and that peculiar property of muscular structure denominated *contractility*.

Fig. 1.

Fig. 2.



Your attention is now invited to an experiment of Cl. Bernard, in which, by the introduction of a poisonous substance placed under the skin, this *contractility* is completely destroyed by acting directly upon the muscular tissue. Here (fig. 2) is a frog in which two hours ago the *sciatic* nerve N was exposed in the back part of the left thigh, and a ligature passed underneath it and tied tightly around the limb so as to cut off the circulation to the lower part. An incision P was then made in the skin of the back, and a solution of the poison sulpho-cyanide of potassium introduced; this has been absorbed by the capillaries and carried by the circulation to every part of the body but the limb around which the ligature was placed. It has destroyed the life of the animal, and you observe on applying the gal-

vanic current that no movement occurs in the parts to which the poison has been carried; an active contraction, however, takes place in the limb unaffected by the sulpho-cyanide of potassium. Bernard and others infer from this experiment, that while the muscles of the poisoned limbs lose their *contractility*, the nerves of the same part retain their *irritability*.

It is asserted by the same authority, Bernard, that when woorara (a poison used by the South American Indians) is applied to a frog prepared like the one just presented, no reflex action can be induced after death in the poisoned limbs, but that spasmodic action will occur beyond the ligated part. This substance is said to destroy the *irritability* of the *motor nerves* without affecting that of the muscles, and in this way the absence of contractility is accounted for. He had experimented to some extent with this article, but did not feel prepared to confirm or disprove the statement by his own observations.

Here is a third frog, however, which has been destroyed by some woorara obtained from a reliable source, and yet you will observe that marked spasms of the body and *all* the extremities occur on applying the *induced electric* current. He did not consider this sufficient, although it is the second time that the same result had supervened in his hands, to assert that the poison has been credited with properties which it does not possess, but, on the contrary, was disposed to believe that there might be something wrong in the article used or its management.

In the course of the preceding experiments, it has been observed that the spinal cord is a great centre with an inherent motory power, which it communicates to its nerves independent of the brain. In a healthy condition the limbs of the human body give very little evidence of a disposition to reflex movements, as they are restrained by the controlling influence of the brain. But when, as the result of *centric* or *excentric irritation*, the spinal cord is in a state of unnatural excitability, (as in hysteria, chorea, epilepsy, etc.,) the uncontrollable reflex movements of the limbs are marked characteristics of these affections. Diseased teeth not unfrequently serve as *excentric* or peripheral sources of irritation in arousing such manifestations. Under such circumstances, the impression made upon the peripheral extremities of the fifth pair of nerves is conveyed to the medulla oblongata, and the train of phenomena is awakened by the impulse sent along the anterior or motor roots of the nerves issuing from the spinal cord and distributed to the muscles. (Fig. 3.)

Fig. 3.

Prof. Morton said, the dispute regarding the relation of vital or nerve force and galvanism may, perhaps, be reconciled, if we allow a very close connection to exist between them without maintaining their absolute identity. Such a connection, for example, as exists between light and heat. Light being only rapidly vibrating heat, heat slowly vibrating light; light convertible into heat, heat into light, the same source often evolving both; the same body often transmitting both, yet again refusing to carry one and yet carrying the other, as in the case of rock salt, which transmits heat and light equally well from all sources, and glass, which allows *intense* heat only to pass, as that of the sun, absorbing more diffused or *lower-toned* heat, like that from a fire. So we may suppose that nerve aud galvanic force are as intimately connected, reciprocally convertible, and often combined, yet separable, and sometimes not equally transmissible by certain structures.

Dr. Gorges said he fully indorsed what Dr. Ellis enunciated in his paper, in regard to systemic trouble induced through morbid conditions of the dental organs. He cited a case that recently occurred in his practice, in the person of a gentleman of nervo-sanguine temperament. On examining a superior canine tooth, much decayed, the dental pulp was found fully exposed; it had not ached for some time, which led him to believe the nerve devitalized. On introducing a fine instrument into the pulp chamber there was no exhibition of pain; but in withdrawing the instrument, he discovered him to be in a fainting condition from the pallor of his face, which was immediately followed by complete syncope. By the application of volatile stimulants to the nose, he very soon recovered. On being asked where he had been, he said he had been to the home of his childhood, in England, and inquired what I had given him—chloroform or ether?—being greatly surprised when told that I had not administered either. What was singular, no very great pain was experienced in the tooth; but the small quantity of blood that followed his return to consciousness was sufficient indication that the nerve was not devitalized.

Adjourned.

The Society met on Tuesday evening, March 1st, 1864, at eight o'clock, in the rooms of the Philadelphia Dental College.

The following was presented by the Corresponding Secretary, Dr. McQuillen:—

A letter from Robert T. Hulme, Esq., of England, acknowledging the pleasure with which he accepted a corresponding membership with the Society. Accompanying this were two works presented by the same

gentleman to the library. Their titles are: "*Contributions to Dental Pathology*, by R. T. Hulme, M.R.C.S., F.L.S.;" "*Elements of Medical Zoology*, Translated from the French of A. Moquin-Tandon, by R. T. Hulme, M.R.C.S., F.L.S."

A letter from the Hon. R. L. McClellan, D.D.S., donating to the library a copy of the *Legislative Record*, of the State of Pennsylvania, for 1863. In presenting this work, the Corresponding Secretary took occasion to say that it contained interesting facts with regard to dental education, which the future historian of the profession might look to with some interest, on account of the record there presented of obstacles placed in the way of progressive effort.

A letter from Dr. W. W. Allport, donating to the library the first volume of the "*People's Dental Journal.*"

On motion, a vote of thanks was tendered to these gentlemen, for the liberality and interest manifested by them toward the Society.

It was also announced that the *Scientific American for* 1864 had been subscribed for.

The Executive Committee desires to express the peculiar pleasure afforded it in presenting the name of Dr. Samuel S. White, as a candidate for Honorary membership.

The high-toned justice manifested in his business relations with the members of our specialty; the eagerness to embrace every opportunity for aiding in the elevation of our professional standard; the liberality which has characterized his connection with dental literature as publisher of a journal truly cosmopolitan, and sincerely devoted to the best interests of dentistry, render it a pleasant duty on the part of your committee to request from the Odontographic Society of Pennsylvania that official recognition of merit which they feel is truly deserved.

Dr. J. L. Suesserott, of Chambersburg, Pa., moved that the report of the committee be accepted, its request granted, its publication ordered, and a copy transmitted to Dr. White, by the Corresponding Secretary.

Dr. White thanked the Executive Committee and the Society for the kind expressions contained in the resolutions which they had passed. The complimentary manner in which they had been pleased to recognize his efforts to advance the science and art of dentistry, was especially gratifying. With respect to the literature of the profession, he could only regret that the DENTAL COSMOS had not attained to the excellence in all its departments, that had been hoped for, but he expected, with the earnest co-operation of the members of the profession, to make it much more valuable, and to extend its sphere of usefulness.

The following address was then delivered on the

"ANATOMY AND PHYSIOLOGY OF EXPRESSION."

BY J. H. M'QUILLEN, D.D.S.,
PROFESSOR OF ANATOMY, PHYSIOLOGY, AND HYGIENE IN THE PHILADELPHIA DENTAL COLLEGE.

Gentlemen:—As the essayist of the evening, having no paper ready to present, my remarks of necessity will be of an oral character. The subject I have selected for your consideration is one which should, and more or less actually does, interest everybody; for although on the part of the many there may not be a recognition of the fact, every one is somewhat of a physiognomist; or, in other words, intuitively seeks within the few square inches of the "human face divine," to discover the mental and social qualities and past experiences of those with whom he is brought in contact, by the relations of business or pleasure. And there the indelible record is made of the mental training, the high and ennobling, or the low and degrading association, and the joys and sorrows each individual being has experienced. Erroneous estimates may be, and frequently are made by the most acute observer, but this is no evidence that the most legible and unmistakable record was not presented in each instance. An opinion of any value is not to be formed by carelessly and indifferently observing the features when in *repose*, or *noting a few changing expressions;* but by a careful and philosophical examination under *all their varying* and *chamelion-like* forms. A false estimate of character may sometimes be due to the fact that the opportunities and circumstances attending the examination have not been of such a nature as to disclose all the face was capable of revealing; for as a *single word* often gives a clear insight of the life and animus of an individual, so a *single look*, indicative of love or hate, hope or despair, will reveal traits of character which the individual fully recognizes the possession of, and studiously endeavors to conceal from the observation of the world.

Aside from this general interest shared by all in the human face, it is important that those engaged in certain departments of life should become thoroughly acquainted with the mechanism, so to speak, by which the record is made. To the speaker, whether in the pulpit, at the bar, or on the stage, *gesture* is all-important; to the artist, whether as a painter or sculptor, *expression* is everything; and last, though not least, to the dentist a faithful discharge of duty demands that he should, in the performance of his operations on the teeth, invariably endeavor to *preserve* the natural expression of the face, or when the ravages of decay have eventuated in the loss of the dental organs, that the lost expression should be *restored* by the introduction of properly constructed and adapted artificial substitutes. To each and all of these, and particularly

to the latter, if they desire to attain the highest possible point of excellence, an intimate acquaintance with the ANATOMY AND PHYSIOLOGY OF EXPRESSION is indispensable. In the brief space allotted to me this evening, little more can be done than to offer, in a general manner, the groundwork on which such an interesting and extended study rests. It would require many evenings, and fill a large sized volume, to do full justice to the theme. With this understanding, permit me in the first place to direct your attention to the main characteristics of the bony framework on which the features rest, for in the language of Tennyson,—

> "Every face, however full,
> Padded round with flesh and fat,
> Is but modeled on a skull."

The roundness and fullness of some faces, the sharp and pinched appearance, or the long and heavy expression of others, is mainly due to the shape and size of the bones on which the features are moulded. In illustration of this, you see on the table a number of craniæ, ranging from the earliest period of infancy to childhood, adolescence, manhood, and extreme old age; and in addition, others belonging to different races, each and all indicating, in a marked degree, the characteristic differences just referred to. In this, for instance, the skull of an infant a month or so after birth, all that portion which contained the brain is relatively large, with a full forehead, but rather flat at the eyebrows, while the bones of the face are diminutive, and their external surface smooth and rounded; no great prominences and depressions, with the exception of the orbital cavities, are presented, and everything contributes to give the plump and meaningless expression characteristic of an infantile face while in repose. Passing to another skull belonging to a child æt. six, the bones of the face are found largely increased in size, and this, along with the presence of the deciduous teeth, serves to lengthen the face, and make it less round than that of the infant. The gradual but marked increase of size in the superior maxillæ presented in these skulls, as we pass from infancy to childhood, from childhood to adolescence, and from adolescence to manhood, is accompanied by a proportionate enlargement of the Antrum Highmorianum; at the same time, as the centre bones of the face, their growth has the effect of increasing the length and prominence of the nasal and malar, or cheek bones. The presence of the large permanent teeth of the adult, and the alveolar processes which support and fix them, serve also to increase the length, breadth, and depth of the superior and inferior maxillæ; and the entire face consequently becomes larger and longer, but not necessarily fuller. In the great majority of cases, indeed, along with the increased

size and lengthened visage, there is a decided and proportionate loss of the roundness and fullness presented in the infantile period. The reason for this is obvious, when observing the great prominence of the nasal and malar bones, and the corresponding depressions in the other parts of the face, particularly the canine fossæ of the superior maxilla. In life, when these depressions are not well "padded round with fat," the cheeks of course present a wan and sunken appearance. In the series here presented, while the bones of the face have gradually increased in size, those of the cranium have maintained a proportionate relation. This prominent ridge in particular, (the supra-orbital,) in the frontal bone of this very fine and perfect adult skull, and which has much to do with expression, is owing to the gradual separation of the external and internal plates of the os frontis at this point, so as to form the frontal sinus. On this ridge the eyebrows rest, although they are usually described as resting on the superciliary ridge; but this is not correct.

It is generally conceded that the proportionate relation of the bones of the face to those of the cranium has much to do with the moral and mental qualities of the individual; in other words, that a high order of intellect is usually manifested by those in whom the cranium is large, the forehead broad and high, and the bones of the face small; while the animal propensities are generally evinced in a marked degree, and preponderate over the intellectual in those with depressed foreheads, compressed temples, and large and massive jaws, as in the case of this eminently prognathian skull of an African, with whose antecedents I was made acquainted by the gentleman who presented the specimen to me. The record in his case is in full confirmation of the position just advanced.

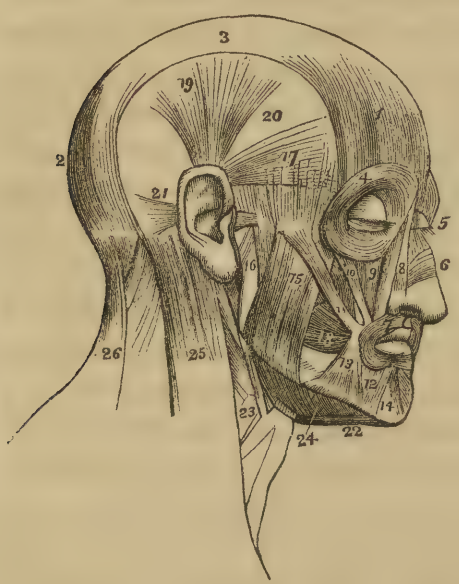
The opposite extreme is sometimes presented, in which the bones of the face are so disproportionately small, in comparison with the cranium, as to constitute a marked deformity. Again, a want of harmony between the different bones of the face is occasionally presented; as, for instance, when the inferior maxilla is very large and massive, or unusually small, in comparison with the superior maxilla, or vice versa. This hypertrophied or atrophied condition may occur in any of the bones, and of course when existing will mar the harmony of the surrounding parts.

In extreme old age, the atrophied condition of the jaws (markedly manifest in this skull, belonging to a very old person) due to the gradual loss of all the teeth, and the absorption of the alveolar processes, produces that decided alteration in the features of the aged with which we are all so familiar. The change which invariably takes place in the angle of the lower jaw in consequence of the disappearance of the teeth and processes, causes the chin to project, and when the jaws are closed the nose and chin approximate each other. Even when apart, the falling

in of the lips so encroaches upon the oral cavity as to make it too small for the tongue, and thus renders the speech feeble and indistinct It is here where the skill of the mechanical dentist finds a field for artistic labor, not only by replacing the lost expression of the face, but also by restoring the medium through which the wants and thoughts of the individual are made known to others.

Arising from various parts of the bony framework, and then mainly converging to one or the other of the two great centres of expression, the eyes and mouth, there are a number of muscles on whose action the varying play of the features depends. Intending by no means to give, at this time, a lengthy and detailed description of these muscles, but rather to notice them casually, with the aid of the drawings, and the large papier-mache manikin here presented, I hope to make myself clearly understood. We will commence with

The *Occipito frontalis* (1, 2, 3,) consists of two broad but fleshy bellies, with an intervening aponeurosis resting upon the arch of the skull, and over which it slides; the posterior portion of the muscle arises from the superior curved line of the occipital bone. The prinpal parts of the anterior fibres are inserted, or blend with the corrugator supercilii, and the superior margin of the orbicularis palpebrarum. The minor portions of the right and left frontal muscles unite together some space above the root of the nose, and are inserted at this point and send down fibres which are continuous with the pyramidalis nasæ. *Function.* It moves the scalp, elevates the eyebrows, and induces the transverse wrinkles of the forehead.



The *Corrugator Supercilii* lies under the occipito frontalis, and is a small, pyramidal muscle, arising from the inner extremity of the superciliary ridge; its fibres proceed outward from their origin and blend with those of occipito frontalis and orbicularis palpebrarum. *Function.* It draws the eyebrows and eyelids inward, and produces the vertical wrinkles of the forehead.

The *Orbicularis Palpebrarum* (4) consists of a thin, flat plane of elliptical fibres, which extend around the whole circumference of the orbit and eyelids. It spreads outward on the temple and downward on

the cheek, but the only fixed points of attachment, however, to bone are at the inner margin of the orbit. *Function.* It closes the eyelids.

The *Pyramidalis Nasi* (5) is usually regarded as a prolonged slip of the occipito frontalis, which continues downward on the bridge of the nose where it blends with the compressor nasi. *Function.* It draws down the inner angle of the eyebrows, and produces the transverse wrinkles on the bridge of the nose.

The *Levator Labii Superioris Alæque Nasi* (8) is a thin, triangular muscle, arising from the upper part of the nasal process of the superior maxilla by a pointed extremity, and, as it descends along the side of the nose, gradually increases in breadth, and then divides into two slips, one of which is inserted into the ala of the nose, and the other blends with the orbicularis oris. *Function.* It elevates the upper lip and ala of the nose, and dilates to a considerable extent the latter organ.

The *Compressor Nasi* (6) arises narrow and fleshy from the canine fossæ of the superior maxilla, and its fibres continuing upward and inward expand into a thin aponeurosis which unites on the dorsum of the nose with that of the muscle of the opposite side. *Function.* The compressors may act either as dilators or as constrictors of the nares.

Depressor Labii Superioris Alæque Nasi, covered by the orbicularis oris, arises from the myrtiform fossæ of the superior maxilla, as a short radiating muscle, whose fibres diverge upward and outward; the ascending fibres terminate in the septum and back part of the ala of the nose; the others curve forward and blend with the upper portion of the orbicularis oris. *Function.* It draws the upper lip and ala of the nose downward, and thereby constricts the anterior nares.

The *Levator Labii Superioris Proprius* (9) arises from the lower margin of the orbit, where it is attached partly to the superior maxilla, and partly to the malar bone; its fibres pass downward and inward, and blend with the upper part of the orbicularis oris. *Function.* It is the proper elevator of the upper lip, and at the same time carries it a little inward.

The *Levator Anguli Oris*, covered by the preceding and the zygomatici muscles, arises from the canine fossæ just below the infra-orbital foramen, and its fibres pass downward and outward to be inserted into the orbicularis oris at the angle of the mouth. *Function.* It raises the angle of the mouth and draws it inward.

The *Zygomaticus, Major and Minor*, (10, 11,) arise, the latter in front of the former, from the malar bone, and then pass downward and outward to the upper lip and angle of the mouth, where their fibres blend with the orbicularis oris. *Function.* They raise the upper lip and draw the corners of the mouth outward, as in laughing.

The *Levator Labii Inferioris* (14) arises from the incisive fossæ of the lower jaw external to the symphysis; the fibres pass downward and a little forward to be inserted into the chin. *Function.* It raises and protrudes the lower lip.

The *Depressor Labii Inferioris* (12) arises from the oblique line of the inferior maxilla, just in front of the anterior mental foramen; it is a quadrilateral shaped muscle, and its fibres pass upward and outward to be inserted into the lower lip. *Function.* It draws the lower lip downward and a little outward.

The *Depressor Anguli Oris* (13) arises from the external oblique line of the lower jaw by a broad base, and its fibres converge as they pass upward to be inserted into the angle of the mouth, where they unite with the orbicularis oris, the zygomaticus major, and the levator anguli oris. *Function.* It draws the corners of the mouth downward, and is the antagonist of the muscles just named; when they all act together, the mouth is drawn backward.

The *Buccinator* (18) is a broad, thin muscle, arising from the outer border of the pterygo-maxillary ligament, and the external surface of the alveolar processes of the upper and lower jaw, commencing at the first molar tooth and passing backward. The fibres of the muscles converge, and are inserted into the angle of the mouth and the upper and lower lips. *Function.* It compresses the cheek, so as to assist mainly in driving air from the oral cavity, as in blowing on wind instruments.

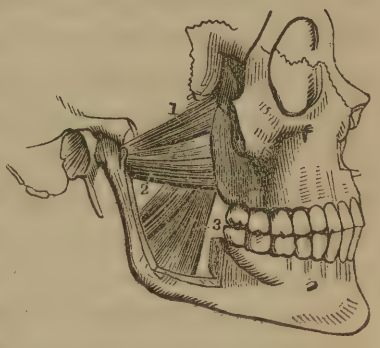
The *Orbicularis Oris* (7) is a great sphincter muscle surrounding the mouth, and although it has no bony origin or insertion, as we have found, a large number of muscles arising from the different bones of the face centre here and blend their fibres with those of this muscle. *Function.* It closes the lips.

While the muscles already described as the superficial muscles of the face are mainly concerned in the varying expressions of the countenance, it must be remembered that those deep-seated muscles, the temporal, masseter, and external and internal pterygoid, which are the active agents in the comminution of food, sometimes play an important part in expression. This is markedly manifest in the aged after the loss of the dental organs, with whom the shortening of the face, the protrusion of the jaw, and the approximation of the nose and chin, under such circumstances, are due to the contraction of these muscles and the influence which they exert in modifying the shape of the lower jaw, by altering the angle which the *ramus* forms with the body of the bone in early manhood. Considerations such as these indicate the propriety of a brief description of these muscles, in connection with the subject under consideration. The first of these,

The *Temporalis*, arises from the entire temporal fossæ and forms a broad, radiating muscle whose fibres, as they descend, converge into a flat tendon which is inserted into the inner surface of the coronoid process of the lower jaw. *Function.* It raises the lower jaw.

The *Masseter* is a quadrilateral-shaped muscle, and arises from the malar process of the superior maxillæ and the zygomatic arch, and is inserted into the posterior third of the outer surface of the body of the lower jaw, and the ramus from the coronoid process to the angle. It has two planes of fibres, superficial and deep. The first pass downward and backward, the second downward and forward. *Function.* It draws the lower jaw upward and forward, or upward and backward.

The *Pterygoideus Externus* arises (1) by two heads from the pterygoid ridge of the great ala of the sphenoid bone, the outer surface of the external plate of the pterygoid process, and part of the tuberosity of the palate bone; and its fibres pass horizontally backward and outward, to be inserted (2) into the neck of the condyle of the lower jaw. *Function.* When the two muscles act together they draw the inferior maxillæ directly forward, so as to make the lower front teeth project beyond those of the upper. The protrusion of the chin in those who have lost their teeth is greatly due to this fact. The lateral sliding motion of the lower jaw in mastication is effected by the alternate contraction of the muscles of the right and left sides.



The *Pterygoideus Internus*, (3,) like the masseter, is quadrilateral in form, and arises from the pterygoid fossa of the sphenoid and the tuberosity of the palate bones; its fibres pass outward, downward, and backward, to be inserted into the inner surface of the ramus and angle of the lower jaw. *Function.* It draws the lower jaw upward, and, from the obliquity of its fibres, also assists the pterygoideus externus in carrying the jaw forward and from side to side.

There are other muscles, in addition to those just described, which are somewhat concerned in expression. Among these are the depressors of the lower jaw and the other muscles of the neck, by means of which the head is thrown into various positions, under the influence of the different passions; but it would be foreign to the subject to present even a brief description of them. It is proper, however, to refer to the ocular group of muscles, for the eye is not only one of the most prominent features of the face, but also one of the most expressive. When the rest of the face is so completely under the control of the will that it is impossible to de-

termine what is passing in the mind of another, the eye frequently reveals everything. So true is this that, when the tongue says one thing and the eye another, men of observation and experience invariably believe the latter. It is the position of the organ, whether in the sidelong, upward, or downward glance; the fixed, prolonged gaze, or the restless, roving motion, that serves as a key, unlocking to the mind of the attentive observer that which another is striving to conceal. The muscles by which these varied movements of the organ are effected are six in number, and consist of two groups, the first of which are four straight muscles, the *Rectus Superior*, *Inferior*, *Externus*, and *Internus;* the second group is formed by two oblique muscles, the *Obliquus Superior* and *Inferior.* In addition to moving the eye upward and downward and from side to side, if all the muscles of either group act together, a retraction of the eyeball is induced by the contraction of the *Recti*, or a protrusion of the ball by similar action on the part of the oblique. Squinting or strabismus, either convergent, looking inward, or divergent, looking outward, which gives such a peculiar expression to the face, is due to a want of harmonious action in the ocular group, and may be caused by overaction or paralysis of a muscle from cerebral disturbance; or it may be the result of imitation. The *Levator Palpebra*, which is included in this group, is the elevator of the eyelid.

The muscles described, like the bony framework on which they rest, would be without motion but for their connection with the brain, through the medium of special nerves, whose function is to give to the various parts of the face that vitality and ever-changing expression which constitutes the charming attraction of the human countenance.

Of the twelve pair of cranial nerves, five pair are concerned in expression, and three of them are distributed to and give motion to the muscles of the eye. Thus the *third pair of nerves*, or the *motor oculi*, sends branches to all of these muscles, with the exception of the motor externus and the obliquus superior, to the first of which pass the *fourth pair*, or *motor externus nerve*, and the second is connected with the *sixth pair*, or *Nervus Pathetici.*

The *fifth* and *seventh pair* of nerves are distributed to the muscles of the face; the latter, also named *portio dura*, or *facial*, emerges from the stylo-mastoid foramen, and then, passing through the parotid gland, is eventually distributed *exclusively* to the superficial muscles in the form of a plexus, named *pes anserinus.* It is purely a motor nerve, upon the integrity of which the expression of the countenance and the varied play of the features depend. This has been demonstrated in the most satisfactory manner by experiments on animals and in pathological conditions in man. Strange as it may appear now, it was formerly supposed that

the painful affection named *tic Douleureux* was seated in this nerve, and resection of it at the stylo-mastoid foramen was frequently performed for the relief of patients, but with no other result than inducing paralysis of the superficial muscles and loss of expression on the side of the face operated upon, the patients being unable to close the eyelid, elevate the ala nasi, or move the cheek or that side of the lips, and yet at the same time still suffering as much from the disease. Paralysis of this nerve is sometimes induced by cerebral disturbance or the presence of a tumor beneath the ear, and is usually denominated Bell's palsy, on account of the true nature of the affection having been made known by Sir Charles Bell, to whose genius and laborious experimental research the world is greatly indebted, not only for their knowledge of this disease, but also for much that is known at present of the nervous system. Paralysis of the *Portio Dura* does not affect in the slightest degree the function of temporal masseter or pterygoid muscles, (and therefore interfere with mastication,) as they derive their nerve force from the *motor branch* of the *fifth pair*. The dependency of these muscles on the motor branch of the fifth can be readily demonstrated by divisions of the nerve on each side in animals, when the lower jaw at once falls, and the subject operated upon is rendered incapable of raising the jaw or masticating its food. If the nerve of one side only is cut, the parallelism of the jaw is destroyed; or, in other words, the muscles of the side operated upon being paralyzed, fail to bring the jaw in contact with the upper, while on the sound side it is effected as usual.

Premising that sufficient has been said with regard to the points already touched upon, we will now pass to the consideration of some of the expressions presented by the countenance when under the influence of the different passions that affect the mind of man. It is impossible to describe all of these; and the attempt, at best, in the consideration of those to which your attention will be directed, must of necessity be merely suggestive to you of an interesting and instructive subject of study, which for years has more or less intuitively engaged my attention: whether when in conversation with others, quietly observing them when engaged in the pursuit of business or pleasure; or watching the delineations of the orator, the actor, the artist; and last, though not least, the truthful revelations of the photograph.

In illustration of this part of the subject, I shall employ a number of drawings, here presented, portraying the different expressions, which are faithful copies of the admirable engravings in Sir Charles Bell's work on the Anatomy and Philosophy of Expression, and to whose eloquent descriptions I not only cordially acknowledge the pleasure derived from their perusal, but also that in the following remarks shall be most happy

if I succeed in presenting a fair synopsis of his extended description of the subject in connection with my own observations and thoughts.

All the facial expressions may be classified under two heads—the exhilarating and the depressing; and the angle of the mouth and the inner extremities of the eyebrows as points where a number of muscles concenter are the most movable parts of the face, and on whose changes expression chiefly depend. No better illustration of this fact can be afforded than in the caricature, with which every one is familiar, representing two faces joined together, in one of which the *elevation* of the angles of the mouth gives a most joyous expression to the face; on reversing or turning the picture upside down, however, depression of the same mouth at the angles produces a correspondingly despondent expression in the other face.

Commencing with *laughter*, you will observe in this picture that the various muscles which have been described as inserted into the *orbicularis oris*, have entirely overcome the action of that muscle whose function is to close the lips. When a ludicrous idea enters the mind, as a general thing it is in vain to try to keep the mouth closed. The antagonistic muscles concentering there exert a force beyond all control, and frequently the more determined the effort not to give way to the inclination, the more marked and explosive eventually becomes the demonstration. The *elevator* muscles, inserted in the upper lip and the angles of the mouth as the active agents in drawing the mouth upward, produce a fullness of the cheeks which, pressing upon the lower eyelids, throws the skin into wrinkles under them. At the same time the teeth are exposed; while by the contraction of the *orbicularis palpebrarum* the eyes are almost concealed, and, by compression of the lachrymal gland, frequently suffused with tears. Together with this, the agitation of the muscles of the throat, neck, chest, and diaphragm produce audible cachinations.

In the reverse of this, or *weeping*, the lips are drawn apart by the converging muscles, but in place of the elevation of the corners of the mouth they are now drawn downward by the *depressor anguli oris;* the nostrils, at the same time, are dilated, and the tears flow profusely from under the convulsively-closed eyelids over the flushed cheeks; while the veins of the forehead are distended and the inner part of the eyebrows are drawn upward and inward by the combined action of the *corrugator supercilii* and the *occipito-frontalis.* The muscles of the throat, chest, and diaphragm are spasmodically affected and the respiration is frequently interrupted by sobs.

Bodily *pain*, the manifestation of which, in the face of our patients, is to us frequently an important means of diagnosis, not only in children, but those of a larger growth, is a condition that particularly claims our

attention from a professional and humanitarian point of view. Here let me say, in passing, that pain is by no means what it is usually regarded, an unmixed evil. Paradoxical as the statement may appear, it is frequently a blessing rather than a curse, as it is the chief means by which we become aware that some important organ is diseased. Without such intimation, the part affected might have become disorganized to such an extent as not only to destroy the function of the organ, but also to place even life itself in jeopardy. This applies with peculiar force to those organs which it is our duty to save; for it is the unpleasant sensation of pain which generally drives our patients to us, and it is the various manifestations induced by the pain endured which enables the experienced practitioner to determine the nature and extent of the difficulty.

In extreme pain, (except in cases where the patient is suffering from periodontitis, when the occlusion of the jaws intensifies the suffering,) the teeth are brought together with great force and ground against each other by the temporal, masseter, and pterygoid muscles; the saliva frequently flows in large quantities from the mouth, which is drawn open laterally; the face is flushed, the veins distended, the nostrils dilated, the eyebrows raised, the forehead thrown into horizontal wrinkles, the eyelids widely opened, and the tears coursing over the cheeks, betray, in the most unmistakable manner, the suffering endured.

In *fear*, the head sinks backward between the elevated shoulders; the eyes are fixed and staring; the eyebrows are raised to their utmost by the *occipito-frontalis*, which, in addition to a contracted state of the scalp, causes the hair to stand on end; the face is ghastly pale, and the cheeks hollow, shrunken, and in convulsive motion, like lips which are wide open, owing to the dropping of the lower jaw; the breathing is short, labored, and spasmodic.

In *rage*, the inflamed and glaring eyeballs, owing to the contraction of the *oblique* muscles, seem ready to dart from their sockets; the brow is thrown into deep vertical wrinkles by the *corrugators;* the nostrils are dilated; while through the clinched teeth but open mouth words of hate are delivered with emphatic force.

In *joy*, the face is lighted up with a smile by the gentle elevation of the eyebrows, the lively and sparkling appearance of the eye, and the pleasant expression of the mouth, which, without being separated, is drawn aside at the corners.

Conscious of the time already absorbed, and desiring to hear from some of the gentlemen who are present from a distance, we will pass over the consideration of other facial expressions which might be referred to, trusting that those which have been so hurriedly described may awaken a desire on the part of all to acquire a thorough and accurate knowledge

of the entire subject, and to make that practical application of the knowledge thus gained of which it is susceptible, but which it does not come within the province of this address to make.

Dr. Atkinson, of N. Y., said that he fully appreciated the detail just given, to which he had listened with interest, and which had generated a peculiar train of thought, which he was incapable of imparting. He dwelt at considerable length upon the varieties of expression, and believed it due to a disturbance of tension. The standing of the hair, a phenomenon attendant upon the emotion of fear, he believed to be somewhat analogous to a surcharge of electricity. The predominance of any passion he regarded as an increase of polarity in one tissue, and its diminution in another.

Dr. Suesserott said that the expression of pain would frequently afford an index for the detection of the source of disease. He questioned the influence of electricity in causing the "hair to stand on end," and remarked, that were it due to such a cause, the hand of another placed upon the head would effect a discharge of the superabundant fluid, and thereby allow the hair to resume its natural position; a result which he believed would not follow, thus indicating its origin from some different source.

Dr. Atkinson remarked that the hand *would* act as a conductor, and instanced the fact that it is instinctively extended toward the head of a petulant child. He said that, although bone is considered the most differentiated structure, the hair and enamel are more so, and nerve aura is least so.

Dr. Fitch, of N. Y., said that there was no more pleasant or profitable subject of study than the human face, and as dentists, we should be conversant with the anatomy and physiology of all the muscles concerned in expression, as well as that of the teeth. He remarked that there are certain teeth whose retention is a matter of the utmost importance, for by their peculiar location and form, they contribute in a much greater degree than some of the others toward the preservation of the natural facial contour; and as such, he would mention the cuspidati, whose loss affects not only the lip, but from their prominence also alters the shape of the alæ of the nose. The fangs of teeth he regarded as all-important in preserving the length and fullness of the alveolar border; a fact, however, which their promiscuous removal would induce us to believe was frequently lost sight of. He advocated the treatment and filling of every *root*, the preservation of which is deemed practicable; and when their removal is inevitable, he would use means to fill up the sockets with osseous structure, rather than suffer their borders to be removed by absorption.

In the introduction of artificial dentures he would aim to simulate nature, and not fall into the too common error of laboring for a *beautiful* result.

Dr. Flagg said that he felt the interest and importance of the subject, in both its theoretical and practical bearings upon dentistry, and yet, as the evening had passed away, he had been less and less inclined to speak, preferring rather to listen to the brothers who were so kindly with us at this time; but the direction which had been spoken to by Dr. Fitch was one in which his heart joined so cordially, that it seemed to him right that he should add his testimony of conviction as to the soundness of doctrine enunciated, and the tangible benefits accruing from the course of practice pointed out by the gentleman. He had almost as often lamented the wholesale extraction of roots as of teeth, but as it was already becoming a test of ability that the dentist should be able to make comfortable and useful anything in the category of *teeth*, he trusted that the proper value would, ere long, be placed upon that portion of the teeth which alone had the power of maintaining the original contour of the face and oral cavity. He spoke of the importance of retaining roots, by proper treatment and filling, for the furtherance of several ends: perfect maintenance of expression; preservation of normal articulation in speech; *power* of mastication by artificial dentures; prevention of "settling" on the part of these substitutes; and various other advantages, which, by the practitioner of the present day, should be regarded as arguments of weight against the too prevalent method of "properly preparing" mouths for "JOBS!" by taking away that basis of expression which it was impossible for us to completely restore, notwithstanding the marvels which the plasticity of continuous gum material and vulcanizable rubber enabled the dental *artist* to accomplish.

Dr. Butler, of Cleveland, Ohio, regarded the study of the human features as pleasing and profitable, and was happy when enabled to remedy any defect of expression. He said that the admiration awakened by the clear, babbling, dancing brook, would far exceed that occasioned by the stagnant pool; but once remove the pebbles from its bed, the dancing and the babbling cease forever, unless a knowledge of their previous position would enable us to restore them to the places assigned them by nature. He said that dental artistic skill should be cultivated, and constitute not grinning, but laughing and talking faces.

Dr. Mills, of Brooklyn, was highly pleased with the remarks of Dr. McQuillen, and fully appreciated the value which must accrue from the study of expression. Like some of the others, he had taken pleasure in scanning the human features, and believed it the only way to obtain correct data for the construction of artificial work. He expressed his interest in the promotion of associated effort; and desired to acknowledge

the kindness and courtesy which he had received at the hands of his Philadelphia brethren.

Dr. Ellis said that the subject, in all its bearings, had been pretty thoroughly considered; yet he felt inclined to add his mite of testimony in favor of the practice just mentioned, and advocated by Dr. Fitch, of retaining all roots, unless from some pathological condition their extraction be indicated. He thought, with that gentleman, the practice of promiscuously removing roots could not be too strongly deprecated; for, in addition to the pain unnecessarily inflicted, every root lost is an injury, which the skill of the artistic workman may cunningly conceal, yet, though closely counterfeited, nature is perfect in many particulars which it is impossible to more than imperfectly imitate.

Dr. Fitch said that he adopted the following motto: "Never consent to remove a tooth that can be saved."

Adjourned.

A MONTHLY meeting of the Association was held on Tuesday evening, April 5th.

Dr. C. A. Kingsbury, Vice-President, in the Chair.

The Executive Committee presented the names of Drs. R. J. Hoffner and Wm. A. Breen as candidates for active membership. The ballot being taken, both these gentlemen were declared duly elected.

Dr. Samuel S. White was elected an honorary member.

The essayist for the evening being unprepared, the following lecture, accompanied with varied, interesting, and practical illustrations, by means of a new and improved apparatus, was delivered.

"POLARIZED LIGHT."

BY HENRY MORTON, A.M.,
PROFESSOR OF CHEMISTRY IN THE PHILADELPHIA DENTAL COLLEGE.

Gentlemen:—The apparatus which I shall exhibit to you this evening is one designed by Dr. Charles Cresson, who for many years has given his attention to the improvement of this instrument, and who has succeeded in developing it, from the very rudimentary and inefficient form in which only it has heretofore been employed, into an apparatus whose power and efficiency I shall in a few moments demonstrate to you. This instrument, the *gas microscope and polariscope*, is of incalculable value in connection with collegiate instruction, for the evident reason that it enables us to demonstrate to a large class at once all those delicate delineations and

minute distinctions of microscopic structure which must otherwise either be left to the private labor of the student, or be at once imperfectly and painfully exhibited by a long and fatiguing process.

The apparatus before you was constructed by Mr. Joseph Zentmayer, whose name, to those familiar with the microscope, is synonymous with every grace of form and perfection of execution in that instrument; who, in one word, is already acknowledged, in this continent, at least, to be the constructor of not only the most beautiful but the best microscopes in the world. Allow me also to mention here that many of the sections of crystals which I shall presently exhibit to you were prepared for me by this same most skillful constructor, and are the first ever produced on this side of the Atlantic, not, however, for want of effort, as the attempt has often been made to produce these specimens, but never before with success.

In this apparatus the light is obtained from a disk of lime revolved by clock-work before a compound oxyhydrogen jet, in which is burned pure hydrogen directly from a large generator and oxygen from a gas-bag. The light is then collected and condensed by a system of four lenses $4\frac{1}{2}$ inches in diameter, having aggregate foci of 3 inches toward and 15 inches from the light. Convenient adjustments of stage support for object-glasses, etc. are of course added, but need not here be detailed.

I shall this evening confine myself to an exhibition of such specimens as require for their development *polarized light*, and will in the first place briefly explain to you the characteristics of light in this condition.

The term polarized light is unfortunate as a scientific term, because it originated in a false theory, and in no respect suggests the true nature of the phenomena it is intended to indicate; but, on the contrary, by calling up magnetic associations, leads the mind astray, instead of directing it to the proper road. The name is, however, an established inconvenience, and we must use it as such, bearing in mind that it is only a sign, insignificant in itself, and to be endowed with a foreign and arbitrary value for our use in this particular subject of study.

By polarized light we mean "screened" or "sifted" light, as thus: An ordinary ray of light we conceive to be composed of particles vibrating in every possible plane perpendicular to its direction; a ray of polarized light, to be one whose particles are all vibrating in parallel planes; in other words, a cross-section of the first would be represented by the spokes of a wheel, of the second by the bars of a grating. This, then, in a very rough and general way, is what we mean by polarized light. Next let us see how we can get it, that is to say, how light may be polarized.

There are three ways of polarizing light: by reflection and refraction, by absorption and by double refraction.

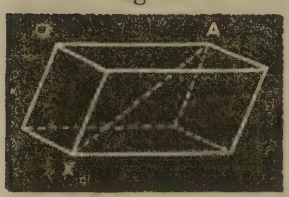
1st. Polarization by reflection and refraction. When a ray of light is

incident upon a plate of glass at an angle of 57° 45′ it is partly reflected and partly transmitted; both these fractional rays will then be polarized, the reflected one having its vibrations all at right angles to the inclination of the plate, the transmitted or refracted one having its vibrations perpendicular to these. To take a rough illustration: the glass acts like an inclined grating, which passes particles moving parallel to its sloping bars, but throws off those vibrating at right angles.

2d. Certain substances, such as the mineral *tourmaline*, or the chemical substance herepathite, (iodo-sulphate of quinine,) have the power of polarizing light by absorbing and destroying all the rays except those moving in one single plane. They act upon light, in fact, as a simple vertical grating would upon a bundle of flat rulers which we might endeavor to pass through, and which would stop all but those which happened to lie parallel to its bars. Two such "gratings" or crystals *crossed* would stop all the light, but parallel would allow the polarized beam to pass. (This fact was illustrated by experiment with the gas-polariscope.)

3d. Certain substances, the chief of which is the mineral Iceland spar, have the property of dividing a ray of light incident upon their surfaces into two, each of which is polarized in a different plane, the two being mutually perpendicular. Figure 1 represents a crystal of Iceland spar, its form being that of the oblique rhombohedron, having an obtuse solid angle at A and X, and all the other angles acute. The line A X, joining these obtuse angles, is called its principal axis, and in this direction alone no double refraction takes place. A ray of light entering the crystal in any other direction is broken into two; the one more refracted, in this case, obeying the ordinary law of refraction, is called the "ordinary" ray; the one less refracted is named the "extraordinary," this last being slightly retarded in its passage through the crystal. If one of these crystals is cut in two in the direction A X, and the two portions are cemented together again with Canada balsam, it will happen that the ordinary ray will be totally reflected on reaching the surface of the balsam, and that the crystal in this condition will transmit a single ray of polarized light, as is shown at the left in Figure 3, where B E is the extraordinary, B O the ordinary ray. By the use of this apparatus, which is called a Nichols' prism, we therefore obtain from a ray of common light (A) having vibrations in all directions, (reducible, however, to two at right angles to each other,) a ray of polarized light, indicated by P, all of whose vibrations are in the same plane.

Fig. 1.



Let us now study some of the results of these general facts. Suppose that the ray P polarized as above comes upon a thin plate of some doubly

refracting substance, say a lamina of mica, (which may be regarded as having openings for the transmission of luminous vibrations in the directions indicated by the crossing lines in F G,) then the polarized ray P will be depolarized or broken up into two waves, Q and R, in the direction of the openings of F G; these waves or rays will not, however, be sensibly separated, because of the thinness of F G, but will come out superposed, one, however, being retarded more than the other. If now these rays meet another Nichols' prism like the first, each of them will be divided into two, S into S′ and S″, T into T′ and T″: S″ and T″ will here evidently be in the same plane, (as also S′ and T′,) and one, say S″, being part of the retarded ray Q, will possess all the conditions necessary for interference of waves and the production of color. This fact you now see demonstrated with the lantern, the brilliant colors thrown on the screen coming from films of mica and of selenite, arranged as indicated in the diagram, their different colors being due to their different thickness. (Various specimens and devices in selenite, as butterflies, flowers, and the like, were here exhibited with beautiful effect, the object at first colorless as thrown upon the screen, acquiring brilliant luminous hues in a moment, as the analyzer or second Nichols' prism was introduced.)

This arrangement just described admits of important application. The power of double refraction possessed by a multitude of bodies, varies in each, and gives us, by reason of this coloring effect, a ready means of discrimination between different substances and various structures otherwise hard to distinguish.

Thus I now place in the lantern specimens of various chemical salts, and though I am using a lens which projects on the screen an image 400 times larger in each direction than the specimen, little can be seen by which to identify each substance; but now I introduce the analyzer, and at once all starts into brilliant and variegated color, with a distinctness of figure sufficient to enable the most hasty observer to distinguish or to recognize. (*Numerous specimens were here exhibited, their distinguishing characteristics pointed out, and adulterated mixtures by this means analyzed.*)

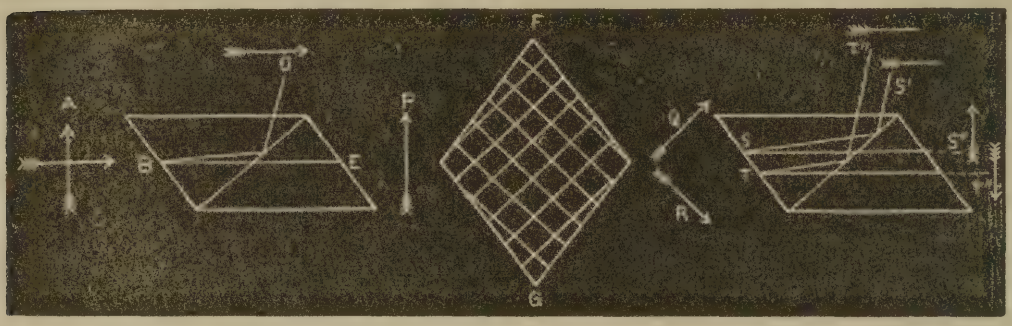
Fig. 2.

If in the place of the film of selenite of mica, we introduce, in a diverging pencil of light, a plate of some doubly refracting crystal, cut perpendicularly to its principal axis, or axis of no double refraction, a beautiful system of rainbow-colored rings, intersected by a white or black cross, will be projected upon the screen.

The formation of these will be readily understood by comparing Fig. 2 (which represents the supposed condition of such

a slice as regards the direction in which the luminous waves can pass) with Fig. 3. About the lines A B and C D, the polarized light can pass freely, thus making a white or black cross, according as it is passed or obstructed by the second prism; while in all the intermediate parts, double

Fig. 3.



refraction will break up the rays with production of color, as in the selenite, the variations in angle, however, producing different tints.

At the close of the meeting it was, on motion, resolved to meet on the following Tuesday evening, at which time Prof. Morton designed lecturing upon the solar microscope and its application to the illustration of specimens of bone, teeth, etc.

No other business being in order, the Society adjourned.

An adjourned meeting of the Society was held Tuesday evening, April 12th, when Prof. Morton delivered the following lecture upon the Solar Microscope.

"THE OXYHYDROGEN MICROSCOPE."

Gentlemen:—The difficulty in scientific educational institutions of exhibiting microscopical structures is evident to all who have been in any way connected with such organizations. It is from histological research that the student must acquire that delicate distinction which renders his future judgment of value. The means of illustration most usually employed—that of exhibiting diagrams—is one which, not unfrequently, conveys to the mind little else than a fanciful representation, conceived in the brain of the painter, and must of necessity be wanting in many of the nicer and finer touches which can only be seen by a self-made examination of the specimen under the microscope.

If the ordinary hand microscope be employed, then the time consumed in viewing the specimens is so great that but few of them can be shown, and, in addition, the student fails to detect important points, because, unaccustomed to the use of the instrument, he is not prepared, even

after a description, to render the view of the object perfectly free from confusion.

With the instrument I have before you to-night, the difficulties mentioned are readily overcome, for no matter what number of persons be looking, each has a thoroughly distinct view of the magnified image of the object thrown upon the screen. In addition, the instructor is himself enabled to see the image, and to point out the features of most importance. In this way an infinite number and variety of structures can be shown without tiring the eye of the beholder or wearying his patience, in waiting until thirty or forty have each in turn seen the preparation.

The microscope employed to-night has a magnifying power of seventy diameters, and, to show the facility with which it operates, I will place upon the stage a few microscopic pictures, and proceed afterward to the exhibition of some organic structures.

Prof. Morton then placed within the field a small picture, not larger than the head of a medium-sized pin, and looking like a speck upon the glass slide, when its image was instantly projected upon the screen, and the figures made to stand out in prominent relief. After showing one or two other objects of a similar nature, a number of specimens of bone and tooth structure were satisfactorily displayed. The *lacunæ*, *canaliculi*, and *Haversian canals*, in the bone, were exceedingly well marked, and the dentinal canals, with the intertubular structure, were shown with admirable distinctness. There was no difficulty in distinguishing the primary and secondary curves of the dentinal tubes, with their branches and anastomoses. The enamel fibres were also well shown, and the lacunæ and canaliculi of the cementum made apparent. The sections of teeth comprised both normal and pathological conditions, including the different classes of teeth, various specimens of exostosis, etc.

After the close of the lecture it was, on motion, resolved to extend an invitation to the members of the various Dental Societies and the profession generally, to attend the first annual meeting of the Society, to be held at the Philadelphia Dental College, on the first Tuesday of May, (3d inst.,) 1864, at eight o'clock P.M.

The meeting then adjourned.

THE HUMAN TEETH IN THEIR RELATIONS TO MASTICATION, SPEECH, AND APPEARANCE.*

BY J. H. M'QUILLEN, D.D.S.,
PROFESSOR OF ANATOMY, PHYSIOLOGY, AND HYGIENE IN THE PHILADELPHIA DENTAL COLLEGE.

An Address delivered before the Delaware Dental Association.

GENTLEMEN:—In compliance with your appointment I appear before you this evening,—not, however, as an essayist, for my time has been so much engrossed by various duties since the nomination as to preclude the possibility of preparing a written address, but rather in an oral communication, which to me, from years of habit in the lecture-room, is decidedly preferable, to invite your attention to the consideration of the *Human Teeth in their Relations to Mastication, Speech, and Appearance.*

The varied and extended character of the subject demands that it should be treated in a general and suggestive manner; and my object in selecting it was, that it might awaken a spirit of inquiry in these various directions, and that the knowledge thus obtained might be made instrumental in securing to patients beneficial, practical results.

To prevent confusion and secure clearness of conception, it will be advisable to consider the subject under separate heads, and commencing with the first.

MASTICATION.—It may be truly said that a just appreciation of the position which the human teeth occupy as masticating agents, can only be obtained by familiarity with the comparative anatomy of the dental organs; for in the structure of the teeth there are certain characteristic differences, corresponding with the habits of the animal and the kind of food upon which it subsists; and in the mouth of man teeth are found belonging to different classes of animals, whose habits and food are of the most opposite character. In illustration of this point, the craniæ of man and various animals, lying on the table, are presented.

With regard to the entire animal series, the teeth may be defined as hard organs situated on the inner surface of the digestive canal, varying in *shape, size, number, and location,* with the character of the materials which they are intended to comminute. By some animals they are employed as offensive and defensive weapons in prehension; by others, as organs of locomotion; again, they are used by certain kinds of fish in

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* The illustrations accompanying this communication were engraved from specimens in my possession.—J. H. McQ.

crushing the stony shells inclosing their food; as in the case of the *sheep's-head fish* and the *parrot-fish*, (*scari.*)

Although man and several of the animals have thirty-two teeth belonging to the permanent set, the typical number of the *vertebrates* is forty-two. Some of them, however, are *edentulous*, or without teeth; others have but one tooth, and from this they range upward to such a large number, that to those who have not examined the subject, it must appear incredible. Thus birds are found invariably *edentulous*, the gizzard serving as the comminuting organ; while at the other extreme, fish are supplied in the most liberal manner with teeth. In many of the vertebrates the teeth are firmly implanted in the maxillary and premaxillary bones. In other cases, as in certain kinds of fish, the teeth are inserted not merely in the maxillary and premaxillary bones, but in the palate bones, vomer, pharynx, on the tongue, and in the stomach; being so numerous, and in such peculiar positions, that it is quite difficult to count them; running as high as one hundred and forty in some, and in others to one hundred and ninety, and beyond. Wherever found, while they may subserve other purposes, they are invariably necessary agents in the prehension or comminution of food.

In fish and serpents, with the exception of the poison-fangs of venomous reptiles, the teeth are merely organs of *prehension*, and prevent the escape of the prey after being seized; and which, as a general thing, is swallowed entire.

The comparative anatomist, in making the diet a means of classification—as in the carnivorous and herbivorous animals—takes advantage of certain marked characteristics in the digestive apparatus to divide these animals. These peculiarities, however, are not confined to the dental organs only, but a constant relation is maintained between the shape and structure of the teeth; the articulation of the jaw; the form of the stomach; the length of the intestines, and the nature of the food on which the animals subsist.

Thus the teeth of the truly *carnivorous* animals are fitted to seize their prey and lacerate the food, but not to thoroughly masticate it. These organs are of three kinds, and adapted to different mechanical purposes. Thus, in the *polar bear*, the *incisors*—six in the *superior* and six in the *inferior maxillæ*—are so formed and situated as to serve as shears in dividing the food. The *canines*—two above and two below—long, curved, and sharp-pointed tusks, possessing great strength, and deeply and firmly implanted in the jaws, are used by the animal as offensive and defensive weapons, and for seizing upon and holding its struggling prey. The *molars*—four on each side, above and below—have cutting or trenchant crowns, with serrated edges and sharp points, which are arranged in

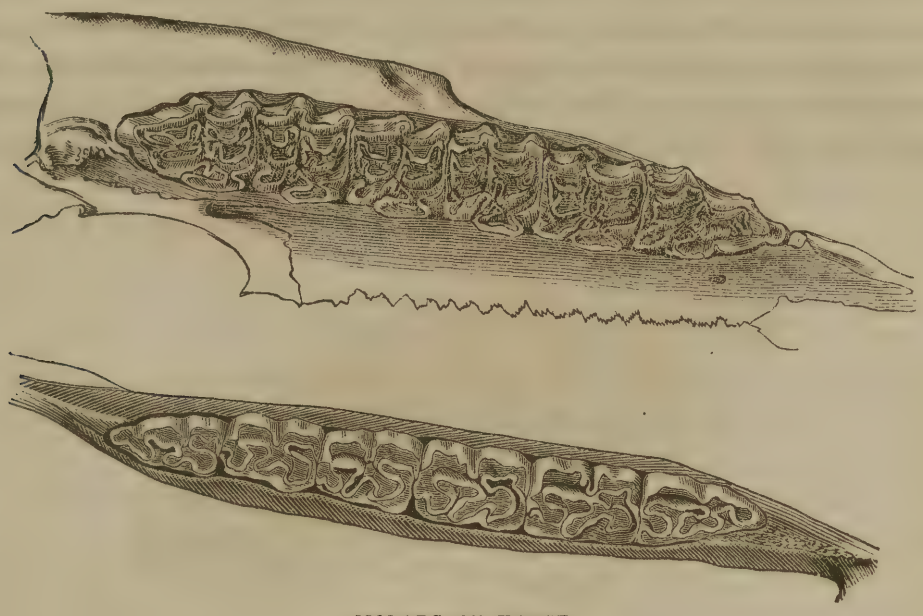
a direction parallel with the line of the jaw; and the superior teeth have a flat inner side, against which the inferior works like a scissor-blade.

POLAR BEAR.

These teeth serve to mangle rather than thoroughly comminute the food of the animal. The jaws are strong, and the deep and narrow glenoid cavities in the temporal bones receive the condyloid processes of the inferior maxillæ in such a manner as not to admit of any horizontal motion, either backward or forward, or from side to side. This articulation, constituting the pure ginglymous, or hinge-like joint, affords the lower jaw only the upward and downward movements. In addition to this, the wide and deep temporal fossæ give an extensive origin to the immense temporal muscles inserted into the coronoid processes of the lower jaw; and the zygomatic processes are very strong and prominent, and the masseter muscles arising from them, and inserted into the rami and body of the lower jaw, are large, broad, and powerful; while the pterygo-maxillary, and pterygoid fossæ, giving origin respectively to the external and internal pterygoid muscles, are, comparatively speaking, quite shallow, and the muscles small. By this arrangement in the shape and position of the teeth, the articulation of the jaw, and the origin and insertion of the muscles, the animal is enabled to seize upon and hold its prey. Any other kind of joint, under such circumstances, would prove not merely unreliable, but actually worthless. In the carnivora the stomach is simple, and the intestinal canal is remarkably short in relation to the length of the body.

Passing to the *herbivora*, and selecting the horse as an example of this class, the *incisors*—*six* in number in both jaws—are arranged in a curve at the anterior end of the jaws, and are employed as prehensile organs in seizing upon and cutting off the herbage on which the animal subsists. The *canines*, small in the horse, and rudimental in the mare, are situated in the upper jaw, in the middle of the long interspace between the incisors and molars, while in the lower jaw they are close to the outer incisors. They subserve no purpose in mastication, this being effected

altogether by the *molars*,—these are six in number, for each side of the upper and lower jaws,—and the crowns of which present two double crescents, the convexity being turned inward in the upper and outward in



MOLARS OF HORSE.

the lower ones. In addition to this, the triturating surface is found to present a series of inclined planes, leading from prominent ridges to large hollow cavities lying at their base; the inequalities thus presented being due to the unequal wear of the different tissues composing the crown. The grass, either in a green or dry state, on which the herbivora subsist, containing as it does large quantities of pure silica or flint, produces decided abrasion of the teeth, particularly the molars. If the teeth, although presenting a rough masticating surface when first erupted, had been composed of only one tissue, they would soon have worn smooth, and proved inadequate to the service demanded. To meet this emergency, therefore, the different tissues composing the teeth—the enamel, dentine, and cementum—are arranged on the same plane. By such a contrivance the teeth necessarily wear unequally, and always present a rough, uneven, grinding surface to the food.

The glenoid cavities in the temporal bones of the horse and herbivorous animals generally are quite shallow, and the condyloid processes of the lower jaw rounded. The joint thus formed not only admits of upward and downward movements, but also of extensive sliding motions in every direction. In addition to this, the temporal fossæ are quite narrow and shallow, the zygomatic processes not very prominent, and the temporal and masseter muscles arising from them are feeble, in comparison with those

of the carnivora. The pterygo-maxillary and pterygoid fossæ, however, are quite deep, and the external and internal pterygoid muscles arising therefrom largely developed. By the action of these muscles the horizontal rubbing motion of the roughened surfaces of the superior and inferior molars against each other is effected, and the coarse articles of food are thoroughly triturated and reduced to a pulpy mass. One *order* of the herbivora—the *ruminantia*—possesses the faculty of returning the food to the mouth and subjecting it to remastication, after it has been once swallowed.

SKULL OF HORSE.

This is due to the remarkable arrangement and action of the stomach, which, as in the cow for instance, is of immense size, and divided into four compartments or stomachs. Another marked peculiarity of this order is the absence of incisors and canines in the upper jaw. The animal, when feeding, after slightly bruising the coarse vegetation by a first mastication, swallows the bolus, which passes along the œsophagus to the paunch or first stomach, and then by small portions to the second stomach, where, after being subjected to an elevated temperature for some time and mixed with the secretions, portions of it are compressed into little pellets, which successively ascend to the mouth, to be rechewed; after this is thoroughly effected, the food is again swallowed, and passes on to the third stomach, a channel being formed through the first two by the contraction of the groove or gutter made by the prolongations of the œsophagus; here it remains a certain length of time, and then passes into the fourth stomach, the true digesting organ, which is analogous to the simple stomach of animals in general.

In *man* the teeth occupy a position intermediate to those of the carnivorous and herbivorous animals. Twelve of the teeth, viz., the *canines* and the *bicuspids*, correspond to those of the former; and twenty, the *incisors* and *molars*, to those of the latter. The *canines*, however, are much less prominent and pointed than in the carnivora; and the *molars*,

while they resemble those of the herbivora, in being thick and strong and presenting comparatively flat surfaces, at the same time, in place of the curvilinear ridges of the herbivora, have more or less conical eminences like those of the carnivora.

HUMAN TEETH.

The form of the articulation of the lower jaw and the organs of digestion, not less than the teeth, present strong evidence that man is truly omnivorous, and afford a clear physiological argument in favor of the mixed animal and vegetable diet which custom and taste have decided to be natural for the human species; while the vegetarian theory, which rigidly excludes everything like animal food, under all the varying circumstances of climate and temperature, is in opposition to the indications afforded not only by the structure, but also by the practice of man. Millions, it is true, avoid flesh altogether, but millions also use it extensively. In the torrid zone there is little or no occasion for its employment, while in the cold climates, particularly in the frigid zone, it is imperatively demanded; and there is no fact more incontrovertible than that the highest order of physical and mental development is found in those countries where the inhabitants unite animal with vegetable food. As there are cutting, tearing, and grinding teeth in man, so the articulation of the lower jaw is intermediate to those of the animal and vegetable feeder. Thus the transverse condyles of the jaw are received into the glenoid cavities, so as to admit of not only upward and downward, but also of considerable lateral or sliding motion; and the temporal,

masseter, and pterygoid muscles effecting this, and the temporal fossæ, zygomatic processes, and the pterygo, maxillary, and pterygoid fossæ from which these muscles arise, hold the same intermediate relation to the animals already referred to. By this arrangement the act of mastication in man, unlike the simple laceration of the food on the part of the carnivora, can be as perfectly effected as in the herbivora; and although the articles of diet are, to a great extent, freed from impurities and softened by cooking, this should be done; for, while some human beings are in the habit of bolting their food, indulgence in such a practice is invariably followed by the most unpleasant results. The human stomach in nowise resembles, as the practice of some would seem to indicate, the gizzard of birds, where hard and otherwise indigestible substances can be triturated; nor does it possess the faculty of returning imperfectly masticated food to the mouth for a second and thorough comminution, as in the ruminantia; neither is it like the stomach of the carnivora, which frequently digests with ease large portions of bone; but it is so constituted as to demand the most perfect and minute division of the food in the mouth. It is truly said that food well chewed is half digested. If, in place of this, it is swallowed in undivided masses, it becomes a source of irritation by remaining a long time undissolved in the stomach; and, if this practice is continued for any length of time, dyspepsia, with its attendant train of horrors, is evoked. The Americans, in their all-absorbing pursuit of business or pleasure, perhaps more than any other people on the globe, violate, in the most reckless manner, this canon, and, as a consequence, lantern jaws and disordered stomachs are universally presented to view. If more time was devoted to the thorough mastication of the food, in place of being time wasted, it would result in increased comfort, physical and mental *power* and *endurance*, and length of years.

Passing now to the second section of our subject, or the consideration of—

Speech, it will be advisable, in the first place, to define the exact difference between *voice* and *speech;* for it is a common error, even among persons of education, to speak of them as if they were one and the same thing, and yet that such is not the case will be evident on the slightest reflection.

Voice is possessed not only by man but also by all of the vertebrata having lungs, and it results from the vibrations induced in the *vocal chords* as the air expelled from the lungs passes through the *glottis*. The sound thus created is capable of being variously modified during and after its production, and it is owing to the mutations induced by the motions of the pharynx, the velum, the tongue, the lips, and other parts of the

mouth, that *speech* or *articulated voice* is produced in man, and in connection with his moral and mental endowments places him above, and gives him dominion over the brute creation, and enables him not only to make known his wants, experience, and thoughts to his fellow-man in his own day and generation, but also by the aid of the written and printed record to transmit them from age to age, thus insuring the constant and progressive development of man's moral and mental powers, and contributing to his physical comfort and well-being.

In the construction of the vocal organs in man nature appears to have combined the double mechanism of wind and string instruments, and it is on this account that it surpasses all musical instruments, by the extent, the perfection, and, above all, by the inexhaustible variety of its effects. Advantage is taken of the function of respiration to convert into a sounding instrument the passages formed by the *trachea* and *larynx*, through which the air is admitted to and expelled from the lungs. The *larynx* is a sort of cartilaginous box placed at the upper end of the trachea, and is composed of five distinct pieces, the *thyroid*, the two *arytenoid*, the *epiglottis*, and the *cricoid* cartilages, which are readily moved on each other by appropriate muscles.

The *thyroid*, which forms the upper and fore part of the larynx, consists of two lateral wings of a quadrangular shape, united in front in a longitudinal angle, which gives the prominence to the fore part of the throat, observable in men, named *pomum Adami*. From the posterior corners of the wings four processes project, which are called the superior and inferior cornua. The *cricoid* cartilage, below and behind the *thyroid*, is shaped somewhat like a signet ring, the narrow part being in front. The *arytenoid* cartilages, much smaller than these, and of a pyramidal shape, are placed one on each side on the upper posterior and lateral parts of the *cricoid*. In other words, the *cricoid* serves as a base on which the *thyroid* and the two *arytenoides* execute the motions by which the *glottis* is contracted or enlarged. The *epiglottis*, resembling the leaf of an artichoke, is attached by its base to the upper and fore part of the *thyroid*, and hangs backward over the glottis, which it closes in the act of swallowing.

These cartilages are connected with each other by ligaments, the most important and interesting of which are the *thyro-arytenoid*, which stretch from the base of the *arytenoid* cartilages to the angle between the wings of the *thyroid;* these constitute the *vocal chords*, and the aperture between them named the *glottis*, as already stated, is the point where the breath is *vocalized*, or rendered not only sonorous but also modulated in its pitch. In the adult male the length of this fissure is from ten to eleven lines, and it is from two to three lines wide where the width is greatest.

The dimensions are much less, however, in the female and in boys prior to puberty, bearing the proportion of 3:2. This is owing to the larynx of men being much larger and forming a more acute angle anteriorly. The different pitch observable in the male and female voice, and in boys is due to these variations. At puberty the larynx of boys is increased in size and changed in form, and the voice is altered. No change, however, takes place in the voice of eunuchs from whom the testes have been removed before puberty. The unsteady, bleating, and weak tone observable in the voice of old persons, is due to ossification of the cartilages of the larynx, an altered condition of the vocal chords, and loss of nervous and muscular power.

That the *voice* is produced in the *larynx* may be readily demonstrated by making an opening in the *trachea* or the *larynx below* the *glottis* in animals; this at once diverts the current of air passing from the lungs, so as to completely destroy the voice; closure of the opening, however, by forcing the air through the proper channels, restores it. If the opening is made *above* the glottis in man, as sometimes occurs in unsuccessful suicidal efforts at cutting the throat, the *speech* is lost but not the *voice*. Again, by blowing with the bellows a current of air through the tracheal end of the larynx of a slaughtered animal, vocal sounds can be produced, which may be varied by changing the tension of the chords.

The preceding and other analogous facts afford data for assuming that the vocal ligaments may be properly regarded as the organs of voice. In a quiescent state they do not lie parallel to each other, but for the purpose of *respiration* the aperture of the glottis is widely open and somewhat triangular in shape, the base of the triangle corresponding to the space between the separated *arytenoid* cartilages; the relative position of the chords, as well as their tension, however, can be varied to a considerable extent through the mobility of the *thyroid* and *arytenoid* cartilages. When, for instance, a vocal sound is made, the action commences with the contraction of certain intrinsic muscles, the *crico-thyroid*, by which the vocal chords are stretched and made tense, while they are brought close to each other, and in a parallel direction, so as to reduce the aperture of the glottis to a mere linear fissure, by the *crico-arytenoideus lateralis* and *arytenoideus* acting upon and approximating the *arytenoid* cartilages. The air, driven by a forcible expiration through this narrow fissure, not only causes the vocal chords to vibrate, but is itself thrown into vibrations, and thus the sound required is produced. As antagonists to the muscles named above, the *thyro-arytenoideus* relaxes the vocal chords, and the *crico-arytenoideus posticus*, by separating the *arytenoid* cartilages, opens the glottis. By such an arrangement as this in the muscles of the larynx, and the mobility of the cartilages, it is sus-

ceptible of an infinite number of changes in form, and capable of producing the finest modulations in the voice. The tone, pitch, and intensity of the different vocal sounds vary with the force of the expiratory effort, the conformation of the larynx, and the degree of tension which is given to the *vocal chords*. The greater the tension of the latter, the more frequent will be their vibrations, and the higher the pitch, or the more acute the sound; while a less degree of tension of the chords and a wider opening of the glottis will produce a grave and deeper note. For the production of the deeper notes the vocal ligaments are so much relaxed that when at rest they are wrinkled, but they become stretched by the current of air, and thus acquire the degree of tension necessary for vibration.

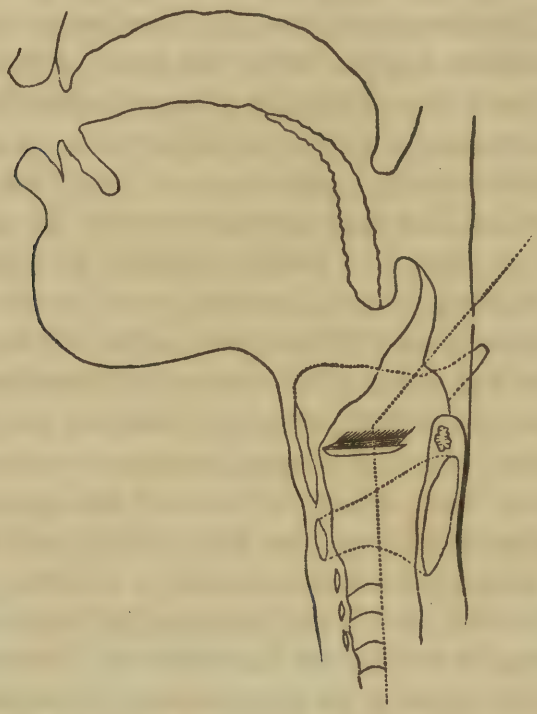
The force of the voice in man depends greatly on the capacity of the lungs and the volume of air which may be expelled from them in a single expiration. This is a point which claims special attention from those who are compelled to speak in public; for much of the discomfort which audiences endure in *listening* to some speakers is owing to the fact that in place of the voice being formed by a steady and uninterrupted current of air welling up in *expiration*, from lungs which were filled to their utmost capacity in *inspiration*, it is produced by the feeble expiration from organs but half inflated, in this way straining the vocal apparatus of the speaker and trying the patience of his auditory. Ignorance of this fact is the most prolific cause of so many clerical gentlemen suffering from *laryngitis*, or *clergymen's sore-throat*. Medical and other teachers often speak for a greater number of hours each week, and yet one seldom if ever hears of their being afflicted in this way, and the same is true of lawyers at the bar, and the majority of public speakers.

Such being the mode in which vocal sounds are produced in the larynx, the next step will be to consider the modifications they undergo in passing through the cavities of the pharynx, mouth, and nose, by which they become not merely vocal but *articulate* sounds, and constitute the elements of speech.

The voice, formed by the passage of the air through the glottis, acquires additional force and intensity, and becomes much more sonorous by the reverberations of the sound in the mouth and nasal cavities and the sinuses with which they communicate. When these cavities are closed by coryza, or the presence of a polypus, or the growth of other tumors, the voice is sensibly weakened and affected, so that it is said to be nasal, though in truth it is not, for it suffers from want of the modifications which it should receive in the cavities connected with the nose. The roof of the mouth, formed by the hard and soft palate, serves as a sounding-board, on which the voice impinges, and is then driven from the mouth. (See Fig. 1.) When the palate is broad and

shallow, the teeth regular and well formed, as in this skull, (see figure at page 139,) and the mouth large, there is nothing to obstruct the

Fig. 1.



passage of the voice, and under such circumstances it is generally clear and distinct, for upon the principle recognized in physics, that the angle of reflection is equal to the angle of incidence, the voice, as it wells up from the pharynx, constituting the incident wave of sound, strikes upon the palate, and the reflected wave meeting with no impediment, is driven directly from the mouth. When the palate is very high, narrow, and angular, and the teeth irregular, as in this skull, (Fig. 2,) the voice, of necessity, is materially affected. For here again applying the principles already referred to, the incident wave of sound impinging upon a *high*, narrow, and angular palate, is of course reflected, but in place of passing freely from the mouth it either strikes upon the alveolus or the palatine surfaces of the front teeth, and is then driven back to the pharynx. The resulting sound arising from this is of the most indistinct, muffled, and cavernous character, and almost unfits a person so constituted from public speaking. The impediment which DEMOSTHENES is said to have conquered was slight in comparison with it. The application of the principles just made no doubt has suggested itself to the minds of others, but I have never heard it expressed or met with it anywhere. It is advanced for what it is worth, and without any pretentious claims to originality, as an idea

which would naturally suggest itself to any thinking mind after observing the different conformation of the parts. The most distressing cases to speakers and listeners are those unfortunate persons who, either from congenital deficiencies or as the result of tertiary syphilis, have an open-

Fig. 2.

ing through the hard and soft palate. Thanks, however, to the application and ingenuity of Dr. Kingsley, of New York, this defect can now be readily obviated, and the speech made clear and distinct.

Speech, or articulated sound, as we have already seen, is a gift peculiar to man, and is the result of education and imitation. Division of these sounds has been made, on account of their origin and variations, into vowels and consonants. They are accomplished by the soft and hard palates, the teeth, tongue, lips, and cheeks, and it is important that these should be in a perfect condition to insure distinct articulation.

The *vowels*, A, E, I, O, U, are continued sounds, which the voice furnishes almost completely formed; as they need for their articulation little more than opening the mouth, at varying distances, by the separation of the jaws and lips, a slight elevation or depression of the tongue accompanying this in the pronunciation of some of the vowels.

The *consonants*, as their name indicates, serve to unite together the *vowels*. Their pronunciation, affected by interruptions to the passage of the air in some parts of the oral cavity, by various and complicated motions of the lips and tongue, the latter of which, when applied to the palate or teeth, narrow or close the channel for its exit, is always less natural and more difficult than the vowels. The most harmonious languages,

and the most pleasing to the ear, are those which use the *fewest consonants* and the *most vowels.* The division of the letters of the alphabet into vowels and consonants, has not been thought sufficient; but the consonants have been further distinguished according to the parts which are more especially engaged in the mechanism of their pronunciation, by the epithets dental, lingual, labial, nasal, and guttural. The special consideration of the exact action of the velum, tongue, and lips in the pronunciation of the different vowels and consonants, would involve more time than we have at our command at present; it is a subject, however, worthy of careful study on the part of the dental practitioner, and intimacy with it must impress upon him the importance and necessity of exercising the greatest care to so conduct his operations, whether upon the natural teeth or in the construction of artificial substitutes, as not to mar the speech of his patient. This would be unfortunate under any circumstances, but when occurring to one who is constantly compelled to speak or sing in public, the importance of the modification becomes immeasurably magnified. For while the improper use of the file, the inexcusable loss of a tooth, or an imperfectly constructed and badly-fitting operation, may not entirely unfit an orator, an actor, or singer, from the discharge of his duties, it is calculated to produce a modification in the speech not only perceptible to the auditory, but the recognition of that fact reacting upon the mind of the person, unfits him for the fullest development of his vocal powers.

In conclusion, it remains for us to consider the teeth in their relation to—

Appearance.—This section of the subject more frequently attracts attention and excites comment on the part of ordinary observers than the portions already discussed, for even those who fail to recognize the importance of the teeth as masticatory organs, or who from physical imperfections in the auditory apparatus, or the existence of mental defects which render them incapable of distinguishing variations in sound, as a general thing at least readily notice any deviation from the ordinary appearance of the teeth. And no single feature of the face is more capable of changing the entire expression than the teeth. This is markedly evident when a classic face, which in repose excites admiration on account of the symmetry and regularity of the features and the purity of the skin, has not only the illusion dispelled at once, but a feeling of loathing induced, by a smile revealing, in place of pearls, blackened and crumbling snags; while, on the other hand, a very ordinary and homely face when lighted up by a smile which uncovers clean, white, regular, and symmetrical teeth, becomes pleasing and attractive.

It is said that the teeth of Americans are more frail, and that the prevalence of dental caries, and, as a consequence, disfigured mouths, is more common with us than with Europeans and people in other parts of the world. Writers generally, in and out of the dental profession, appear disposed to adopt this as an unquestioned fact; for my own part, however, I am somewhat inclined to doubt the accuracy of this conclusion, for persons whose intelligence, keen perceptions, and clear judgment can be relied on, have informed me that when traveling through Europe they have paid special attention to this matter, and have found the teeth of the inhabitants of the countries through which they passed not merely as bad, but a great deal worse than Americans, for they do not pay that attention to the preservation, or restoration of the organs which is so universal with us.

Again, it is asserted, as an evidence of the physical degeneracy of our times, that the teeth of the present day are greatly inferior to those of preceding generations. This, however, is an open question, as the opinion merely rests upon suppositions and not reliable data. It is inferred, for instance, because hale and hearty parents and grandparents who have attained to a green old age, and retaining their teeth, in keeping with the general physical conformation, that all, or a vast majority of the teeth of the generations to which they belonged, were equally as good. It is much more reasonable, however, to believe that the same physical weakness and the operation of external influences which shortened the lives of millions who were born at the same period, produced the same effects upon the teeth of these millions, as we notice in those of our own day.

Unfortunately we have no exact data to go upon, so far as the universality of dental caries is concerned in the past; but the testimony of SHAKSPEARE, that—

"No philosopher ever bore the toothache patiently,"

proves that it has prevailed to a greater or less extent in all time. With regard to preceding generations in our country, we have the testimony of MOORE, who, in giving a description of a party with whom he traveled through Virginia in 1802, says of one of them:—

"What a pity, blooming girl,
That lips, so ready for a lover,
Should not beneath their ruby casket cover
One tooth of pearl!
But, like a rose by the church-yard-stone,
Be doom'd to blush o'er many a mouldering bone!"

And then adds in a foot-note, "Polygnotus was the first painter, says

Pliny, who showed the teeth in his portraits. He would scarcely, I think, have been tempted to such an innovation in America."

How much of this statement is to be relied upon as truthful of that period, and what allowance is to be made for the imagination of the poet, and the disposition to satirize a people whom he neither understood nor admired, is now difficult to determine. In whatever way we accept the testimony, it is at least evident that our teeth have not become worse; but, on the contrary, it is rather to be hoped that on account of the attention which they now receive in contrast to a former period, when there were few if any skillful dental practitioners, that they have rather improved than otherwise.

To whatever extent dental caries may prevail within our own country or elsewhere, there is no face, however beautiful or homely, that is not more or less affected by the condition of the teeth; to this end therefore it is important that irregularities of the teeth should be corrected, if no other reasons existed in favor of such efforts; and that every exertion should be put forth to save the natural organs when affected by decay. For to do this is the highest order of surgery, and in all, but very rare and exceptional cases, artificial substitutes, however perfectly constructed, fail to entirely restore the lost expression. It is not enough, however, to merely save the teeth, but the aim should be to preserve, so far as it is possible, the natural form and size of the organs, and to so conduct, and construct the operations as to make the least possible exhibition of them when the patient opens his mouth. However gratifying it may be to the pride of a dentist to have his work made evident to all men in this way, if an operation or a series of operations have been accomplished at an *unnecessary* and *unjustifiable* loss of the anatomical characteristics of the teeth and a great part of their utility as masticatory organs, the work, however beautiful to look upon as a mere piece of handicraft, cannot be regarded as in the fullest sense a complete success, or as a course which should be commended or adopted by others. There are cases in which the operations, on account of the extensive ravages of decay and the portion of the tooth affected, must show. To these, of course, the remark just made has no reference.

The general appearance of the face is not merely affected by the condition, presence, or absence of the front teeth, but the hollow, sunken cheek reveals in the most unmistakable manner the loss of bicuspids and molars. The symmetry of the face in this way is frequently destroyed by the inexcusable extraction of these teeth because a proper valuation is not placed upon them as masticatory organs, and on the score of appearance, by practitioners and patients, it being supposed that, as back teeth, their absence will never be noticed. As an illustration of the effect sometimes

produced by the adoption of such a course, observe this skull, in which you see that the orbit, the malar, and superior maxillary bones on the left side are very much depressed or lowered in comparison with the right side; and this, beyond a question of doubt, is due to the extraction of the left inferior molars, and must have given a very singular expression to the person during life. There are very few faces, when examined critically, in which both sides will be found symmetrical, or in harmony with each other. One side, for instance, will be round and full, and the other hollow and sunken; after making every allowance for congenital defects, falls, blows, and other accidents, in the majority of these cases the variation or deformity, for it often amounts to that, has been caused by the loss of molars and bicuspids, many of which might have been saved if their true value had been duly appreciated.

In the introduction of artificial teeth, the greatest care of course should be exercised to preserve or restore the natural appearance of the face. To do this with any prospect of success, however, it is important that the anatomy and physiology of expression should be made a careful object of study.

It is important, for instance, that the teeth should be so arranged as not to give a sunken appearance to the mouth, or to make it so prominent as to obliterate the groove or depression in the middle of the upper lip; the concavity which naturally belongs to the space between the lower lip and chin; and the lines which the action of the muscles create on each side of the mouth, extending from the wings of the nose to the corners of the lips.

TABULAR LIST OF BOOKS DONATED TO THE LIBRARY DURING THE PAST YEAR.

September 1, 1863.

Dr. J. H. McQuillen.—Dunglison's Physiology, 2 vols. Miller's Principles of Surgery.

Mrs. Dr. Wells, through Dr. Kingsbury.—An Examination on the Question of Anæsthesia, by Hon. Truman Smith. An Essay on the Teeth, by Dr. Horace Wells.

January 5, 1864.

Dr. Abr. Robertson, Wheeling, West Virginia.—Manual on the Extraction of Teeth, by Abr. Robertson, D.D.S.

Prof. Henry Morton.—Silliman's Journal of American Science, 17 volumes.

February 5, 1864.

Dr. J. F. Flagg.—Fitch's System of Dental Surgery. Bell on the Teeth. Odontalgia, by S. Brown. Harris' Characteristics of the Teeth and Gums. Godman's Addresses.

March 1, 1864.

Robert T. Hulme, Esq., London, England.—Contributions to Dental Pathology, by R. T. Hulme, M.R.C.S., F.L.S. Elements of Medical Zoology, translated from the French of A. Moquin-Tandon, by R. T. Hulme, M.R.C.S., F.L.S.

Dr. R. L. McClellan.—Legislative Record for 1863.

Dr. W. W. Allport.—First Volume of People's Dental Journal.

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